MONTHLY WEATHER REVIEW.

Editor: Prof. CLEVELAND ABBE. Assistant Editor: HERBERT C. HUNTER.

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The MONTHLY WEATHER REVIEW summarizes the current manuscript data received from about 3,500 land stations in the United States and about 1,250 ocean vessels; it also gives the general results of the study of daily weather maps based on telegrams or cablegrams from about 200 North American and 40 European, Asiatic, and oceanic stations.

The hearty interest shown by all observers and correspondents is gratefully recognized.

Acknowledgment is also made of the specific cooperation of the following chiefs of independent, local, or governmental services: R. F. Stupart, Esq., Director of the Meteorological Service of the Dominion of Canada; Señor Manuel E. Pastrana, Director of the Central Meteorological and Magnetic Observatory of Mexico; Camilo A. Gonzales, Director-General of Mexican Telegraphs; Capt. I. S. Kimball, General Superintendent of the United States Life-Saving Service; Commandant Francisco S. Chaves, Director of the Meteorological Service of the Azores, Ponta Delgada, St. Michaels, Azores; W. N. Shaw, Esq., Director Meteorological Office, London; Maxwell Hall, Esq., Government Meteorologist, Kingston, Jamaica; Rev. L. Gangoiti, Director of the Meteorological Observatory of Belen Collegel Havana, Cuba; Luis G. y Carbonell, Director, Meteorologica, Service of Cuba, Havana, Cuba; Rev. José Algué, S. J., Director of the Weather Bureau, Manila Central Observatory, Philippines; Maj. Gen. M. A. Rykachef, Director of the Physical Central Observatory, St. Petersburg, Russia; Carl Ryder, Director, Danish Meteorological Institute, Copenhagen, Denmark.

As far as practicable the time of the seventy-fifth meridian is used in the text of the MONTHLY WEATHER REVIEW.

Barometric pressures, both at land stations and on ocean vessels, whether station pressures or sea-level pressures, are reduced, or assumed to be reduced, to standard gravity, as well as corrected for all instrumental peculiarities, so that they express pressure in the standard international system of measures, namely, by the height of an equivalent column of mercury at 32° Fahrenheit, under the standard force, i. e., apparent gravity at sea level and latitude 45°.

FORECASTS AND WARNINGS.

By Prof. E. B. GARRIOTT, in charge of Forecast Division.

A barometric depression that past west of Luzon, Philippine Islands, about May 26, apparently advanced thence on a northerly course over or near the Japanese Islands, where its presence was indicated June 1 and 2.

In the United States June opened with high barometric pressure and low temperature for the season over the north-central valleys, the Lake region, and the Middle Atlantic and New England States. To the westward of the high area there was a barometric depression that covered the Rocky Mountain and Plateau districts. This depression drifted slowly eastward to the north Atlantic coast by the 9th, attended in the interior States east of the Rocky Mountains by heavy rains, and in localities in the middle-west and north-central valleys by severe local storms.

On the 9th the following special forecast was issued:

There are no present indications of unseasonably high temperature in any part of the United States. In the Middle-Eastern and Northeastern States the weather of the next three days will be generally fair, with moderate temperature. A barometric depression that will appear over the Rocky Mountain districts Wednesday will move slowly eastward over the Plains States Thursday, cross the central valleys Friday and Saturday, and reach the Atlantic coast Saturday or Sunday. Local rains and a slight rise in temperature will attend the advance of the low area, and following its passage there will be a day or two, the beginning of next week, of somewhat lower temperature from the north-central valleys to the middle and north Atlantic coasts.

From the 10th to the 15th a barometric depression moved from the Rocky Mountain districts to the Atlantic coast, attended by rains that in parts of the Middle-Western States were heavy. In the Middle Atlantic and New England States the rain of the 15th relieved a dry spell that was becoming serious. An area of high barometer that appeared over Bering Sea on the 10th advanced over the British Northwest Territory by the 12th, covered the Missouri Valley on the 13th and 14th, the upper Mississippi Valley and the western Lake region on the 15th, and reached the Atlantic coast on the 16th, attended by fair and cooler weather that continued over the eastern districts several days.

On the 15th the following special forecast was issued:

The period of persistent heavy rains of the last two weeks that has caused destructive floods in the Middle-Western States will end by Thursday. Temperature will rise in the Plains States and central valleys after Tuesday, and the warmer weather will reach the Atlantic States about the close of the week. Next week will open warm over the eastern portion of the country.

Local rains will occur over the Plains States Tuesday, in the central valleys and Lake region Wednesday and Thursday, and reach the Atlantic States by Saturday.

The heavy rains of the Middle-Western States practically ceased Thursday. Following the termination of the rain period the first well-defined warm wave of the season set in over the interior districts and extended to the Atlantic seaboard by the close of the week.

On the morning of the 22d the following forecast was issued:

The warm wave that now covers the country generally east of the Rocky Mountains will break over the Plains States Tuesday, over the Mississippi Valley and the western Lake region Wednesday, in the Ohio Valley and eastern Lake region Wednesday night, and over the Atlantic States Thursday. Local rains and thunderstorms will attend the advent of the cooler weather in the several sections named. Moderate temperatures will be experienced over the eastern portion of the country during the closing days of the week.

This warm wave was of unusual intensity and duration for the season and it terminated in the several districts as indicated in the forecast. As indicated also by the forecast, the temperature over the eastern portion of the country was moderate during the closing days of the week ending June 27.

During the last five days of the month a barometric depression advanced from the Rocky Mountain districts to the Atlantic coast, preceded by temperatures above the seasonal average and attended in the middle and northern districts by local rains and thunderstorms that in localities were heavy. This depression was followed by cooler weather thruout the interior of the country that reached the Atlantic seaboard at the close of the month.

The Paterson, N. J., Press, of July 3, has the following edi-

torial regarding a forecast issued by the Weather Bureau at Washington on June 29:

The Weather Bureau's prediction made on Monday last that there would be a break in the warm wave on Thursday evening came true and was a splendid exhibition of what might be called "long-distance predicting." The sudden change from the almost unbearable heat and humidity that prevailed during the day was most agreeable and invigorating. The heavy shower aided materially in bringing about a more comfortable condition of affairs.

BOSTON FORECAST DISTRICT.*
[New England.]

The month as a whole was warm and dry, and at the close the drought was being severely felt in all sections. There were no high winds or gales on the coast and no storm warnings were issued.—*J. W. Smith, District Forecaster.*

NEW ORLEANS FORECAST DISTRICT.*
[Louisiana, Texas, Oklahoma, and Arkansas.]

The month was warm and precipitation was deficient over the greater portion of the district. No general storms occurred on the west Gulf coast and no storm warnings were issued.—*I. M. Cline, District Forecaster.*

LOUISVILLE FORECAST DISTRICT.*
[Kentucky and Tennessee.]

Temperature averaged about normal, and, except in scattered localities, precipitation was somewhat below normal. The greater portion of the rainfall occurred in the first decade of the month.—*F. J. Walz, District Forecaster.*

CHICAGO FORECAST DISTRICT.*
[Indiana, Illinois, Michigan, Wisconsin, Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas, and Montana.]

Temperature conditions were unimportant. Rainfall was above normal practically over the whole district, the excess being the most decided in the middle Missouri Valley. The rains were as a rule successfully forecast. Storm warnings were issued on the morning of the 19th, and the warnings were verified at a majority of the Lake stations. Frost warnings were issued for the lowlands of Michigan and Wisconsin on the 1st, 9th, 10th, 11th, and 14th. Freezing temperature was reported in the cranberry marshes of Wisconsin on four of these dates, and in portions of Michigan on two. The cranberry marshes were flooded, and damage from frost was consequently averted.—*H. J. Cox, Professor and District Forecaster.*

DENVER FORECAST DISTRICT.*
[Wyoming, Colorado, Utah, New Mexico, and Arizona.]

The mean temperature was considerably lower than usual, except in south-central Colorado. Precipitation was in excess in the northwestern half and deficient in the southeastern half of the district. In south-central Colorado the long-standing drought was unbroken.—*F. H. Brandenburg, District Forecaster.*

SAN FRANCISCO FORECAST DISTRICT.†
[California and Nevada.]

The month was one of continued cool weather and, until the last week, the usual summer afternoon high temperatures were missing. In Nevada unsettled weather continued until the middle of the month. The only coast disturbance appeared on the 20th. Southwest storm warnings were displayed and verified.—*A. G. McAdie, Professor and District Forecaster.*

PORTLAND, OREG., FORECAST DISTRICT.†
[Oregon, Washington, and Idaho.]

As usual June was a quiet month. Temperature was unusually low in eastern Oregon and southern Idaho. There was a marked excess in rainfall in southern Idaho and a marked deficiency in the Willamette Valley and the Sound country. No wind storms occurred.—*E. A. Beals, District Forecaster.*

RIVERS AND FLOODS.

As has been frequently remarked, June is preeminently a month of floods, and those of the present month so far exceeded the majority of their predecessors in extent or duration, or both, that they are entitled to take front rank with the great floods of 1844, 1897, and 1903. They were probably not quite so great when measured by actual water stages as the floods of these former years, but they were equally if not more extensive, and were doubtless greater if measured by their duration and by the amount of losses and damage sustained.

At the end of the month several of the rivers of the Mississippi watershed, including the lower Mississippi, were still in flood. A number of special reports have not been received and it is therefore thought best to postpone for another month the description of these floods. Another report that will also appear at a later date is one on the annual rise of the Columbia River for the year 1908.

The Trinity River of Texas continued in flood thruout its entire length during the month, and it did not fall below flood stage until July 5. The crest of the Brazos River flood reached Booth, Tex., on June 6. A report of this flood covering essential points was included in the MONTHLY WEATHER REVIEW for May, 1908. The crest stages of the Trinity River from Long Lake to the mouth were the highest on record, especially at Long Lake, where the maximum stage of 51.8 feet, 16.8 feet above flood stage, occurred on June 4.

Heavy rains during the first few days of the month over the northern Rocky Mountain districts were followed by destructive floods in all streams of western Montana, eastern Idaho, and northern Wyoming. No river and flood service is maintained on those rivers and detailed reports are therefore not available. The losses and damage, while very large, were of the usual character, with the railroads as the greatest sufferers.

East of the Mississippi River there were no floods during the month, except in some of the smaller streams of New York, where heavy rains about the middle of the month did much damage. The Ohio River was at moderate stages thruout the month.

The highest and lowest water, mean stage, and monthly range at 213 river stations are given in Table IV. Hydrographs for typical points on seven principal rivers are shown on Chart I. The stations selected for charting are Keokuk, St. Louis, Memphis, Vicksburg, and New Orleans, on the Mississippi; Cincinnati and Cairo, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock, on the Arkansas; and Shreveport, on the Red.—*H. C. Frankenfield, Professor of Meteorology.*

* Morning forecasts made at district center; night forecasts made at Washington, D. C.

† Morning and night forecasts made at district center.

SPECIAL ARTICLES, NOTES, AND EXTRACTS.

A GRADUATE SCHOOL OF METEOROLOGY.

The Association of American Agricultural Colleges and Experiment Stations has adopted one of the wisest plans conceivable for the increase and diffusion of sound knowledge relative to agriculture, i. e., the establishment of a graduate or post-graduate school, in which lectures and experiments by experts and specialists bring home to interested audiences the present state of our knowledge, the trend of current thought, and the outlook for the future.

The third session of this school was held at Ithaca under the auspices of the New York Agricultural Experiment Station, July 6–31, 1908. The program shows that the instructors and students were kept very busy with their lectures and seminars; the latter are nearly equivalent to the laboratory work of the botanical, physical, and chemical laboratories, in

which the instructor personally guides the student along lines of special investigation. Seven general subjects were treated during this session, i. e., biochemistry, agronomy, horticulture and plant physiology, dairy husbandry and dairying, poultry husbandry, veterinary medicine, entomology. For each of these subjects there were one or two morning hours for lectures and two afternoon hours for seminars. There were, moreover, special Saturday exercises and popular lectures on Wednesday and Friday evenings.

Altho climate, i. e., sunshine and weather, are of vital importance in agriculture, yet we find but little mention of this subject in the program. The nearest approaches to it are the following topics:

C. G. Elliott: Drainage of land.
S. Fortier: Irrigation problems.
L. J. Briggs: Environment; Evaporation; Solar energy.
L. B. Judson: Effect of acetylene light.
G. H. Powell: Storage and transportation.
J. C. Whitten: Phenology.
J. G. Needham: What shall be done with the marshes?

This omission of the study of climatic conditions is doubtless due to the fact that man can not easily change or experiment with the local climate; he must adapt his methods and plants to the climate, and must achieve success in spite of the current weather.

Possibly climatic influences on crops are not yet sufficiently understood to warrant an attempt to diffuse exact knowledge on this subject. Possibly we have been attaching undue importance to natural climate, i. e., weather and sunshine, as compared with man's modifications of soil and cultivation and the artificial evolution of varieties adapted to the locality.

It is true that during the growing season in any locality there must needs be few frosts, sufficient rain or irrigation water, abundant sunshine and heat. These factors, notwithstanding their large annual variations, are usually so balanced that skilful cultivation and manuring insures a good crop. The work done by man is as essential as that done by nature, so that it is not fair for man to grumble at nature if he fails to raise a good crop.

However, without urging the agriculturist to give climatology a more prominent place in his postgraduate school of agriculture, we must profit by the good example he has set us and, as meteorologists, urge that there be also established a postgraduate school for advanced study in our own important branch of science.

The undergraduate and elementary courses pursued in American colleges and high schools, the various miscellaneous courses of lectures and instruction offered and maintained by the forecasters, section directors, and professors of the Weather Bureau under disadvantageous circumstances, all need to be supplemented by additional facilities. The importance of our subject may be brought into discredit by imperfect presentation.

We believe that there may be as many as fifty or one hundred persons in the United States who would embrace an opportunity to spend a month of strenuous effort in bringing themselves up to a higher standard of knowledge concerning climates and weather. It may be that the Secretary of Agriculture and the Chief of the Weather Bureau have no legal authority to establish such special courses of technical instructions. Congress has imposed on them only the duty of utilizing for the public benefit what little we know of agriculture and meteorology, and they can do little beyond this. But as it *is* their duty both to make new discoveries, to increase knowledge and to disseminate it among the citizens, therefore they should be allowed to carry on every method that gives promise of accomplishing these desirable results.

Now the "seminar" that forms such a predominating part of the work of the Graduate School of Agriculture, is more precisely a daily conference between the advanced pupil and the master who is a little way ahead of his pupil. The master undertakes to show the pupil just how important items of our knowledge have been obtained, but the pupils ask many questions, and it is a dull master who does not perceive when his bright pupil is on the road to making some real addition to our knowledge. Not that he will open up a new world to us, but that he may at least settle accurately some point about which our present knowledge is rather hazy. It is thus that step by step they climb the hill of science together. Thus the muses who bear the torches of knowledge light the lamps of the children of men. Thus we learn to see with the eye of the telescope and the microscope, and to feel with the fingers of the scale beam and the standard gage.

How can an annual meeting be arranged covering some weeks of daily lectures and conferences between our older and younger meteorologists, at which each shall give to the other of his store of wisdom and experience? Six hundred Weather Bureau observers and employees, 2,500 cooperative observers, 5,000 teachers, and 100,000 pupils are interested in propositions such as this which contemplates decided advances in meteorology. At present we rely too much on books and letters; we shall do better to get together, ask questions, try experiments, and compare notes.—*C. A.*

PROGRESSIVE CLIMATIC VARIATIONS ON THE ISTHMUS OF PANAMA.

By Brig. Gen. HENRY L. ABBOT, U. S. Army, retired, late member, Board of Consulting Engineers. Dated Cambridge, Mass., June 12, 1908.

The study of progressive variations in physical quantities admitting of measurement has largely contributed to the advance of science. For example, that the so-called solar constant of radiation is subject to progressive changes, involving a small temperature fluctuation upon the earth nearly simultaneous with the sun-spot cycle, has been suggested by recent astrophysical researches supplemented by elaborate studies of temperature records at coast and specially at inland stations.

It is well known that the movement of the sun in declination regulates in a marked degree the precipitation upon the Isthmus of Panama, causing annually a normal succession of dry and rainy months as, carrying its rainbelt, it oscillates between the Tropics; and it would seem to be of interest to determine, as well as existing data will permit, whether there are other periodic changes in the Isthmian climate for which perhaps an explanation may be found.

But aside from the purely scientific interests of the question a knowledge of any periodic variations in rainfall, entailing corresponding changes in the volume carried by the Chagres River, is locally important from its bearing on the water supply of the canal, as well as upon the probable conditions attending its construction in the immediate future. That the de Lesseps Company worked under specially unfavorable climatic conditions is an historical fact, and the probabilities for the next few years are well worthy of investigation.

The records available consist of nearly continuous rainfall measurements at Colon made by the Panama Railroad Company from 1863 to 1874, inclusive; those made later at Colon and Gamboa by the two Canal companies and the Liquidation from 1881 to the transfer of the property to the United States in 1904; and those continued to date by the Isthmian Canal Commission. The Colon rainfall records for the years 1875 to 1880, inclusive, are quoted from Plate XXXVIII of Part IV of the Twenty-second Annual Report of the U. S. Geological Survey, the authority not being stated. Closely related to these data are the fluviograph records of water heights at Gamboa which are nearly continuous since 1882. These auto-

[1] Earlier papers on Isthmian rainfall may be found in Monthly Weather Review, February, 1907, XXXV, p. 74, 75.

matic records furnish, monthly, precise information as to the number of freshets and the number of hours during which the water level rose above the normal stand adopted as the lower freshet limit, this limit being about 10 feet above dead low water in the river, or 17 meters above mean tide, which is the same in both oceans. Below this level the Chagres River is a gentle stream ranging in discharge between 350 and 1,150 cubic feet per second, while in the freshets of the rainy season it often attains during twenty-four hours a volume of 15,000 to 30,000 and in greater floods even 60,000 cubic feet. With such a regimen the relative monthly discharge becomes practically a function of the number of these freshets and of their duration, and a knowledge of the latter gives the basis for a trustworthy estimate of the relative monthly flow of the stream. This knowledge we have since January, 1883, except for the years 1889 and 1896. Finally, we have nearly continuous gagings of the daily outflow from the basin above Bohio (about 700 square miles) since January, 1890; and, since January, 1898, a precise knowledge both of the downfall and of the outflow, the former based on rainfall records well distributed thruout the basin. It remains to consider how these data can be coordinated to exhibit any progressive climatic change for as many years as possible.

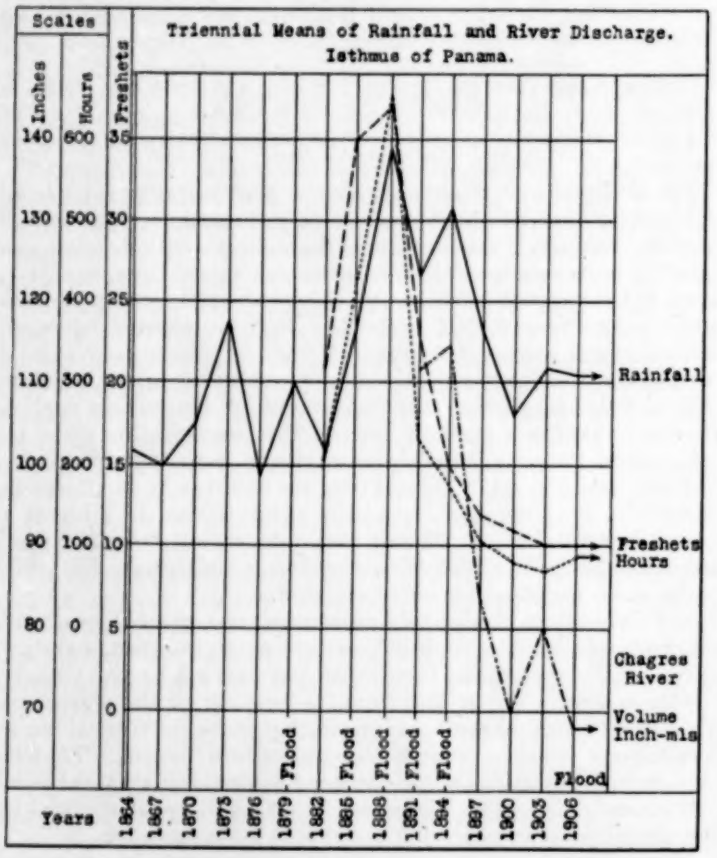

FIG. 1.

As stated above, the annual rainfall records begin at Colon in 1863, and at Colon and Gamboa, jointly, in 1881. It is, however, desirable to know not merely the amount of local downfall, but how much fell over a considerable area such as the basin above Bohio; whether this can be derived logically from the data for the early years is the first point to consider.

Rainfall on the Isthmus is greatest near the Atlantic coast, where it averages about 130 inches, and is least near the Pacific coast, where it averages about 60 inches; in the interior it falls off gradually from one to the other. The basin above Bohio touches the district of Atlantic coast precipitation both at Bohio and at the headwaters of its chief branch, the Pequeni, while Gamboa lies in the interior at a point of the basin most nearly approaching the Pacific coast. These facts suggest that perhaps it may be possible to form an approximate estimate of the downfall over the whole basin from the known figures at Colon and Gamboa, in other words, to generalize the local data. This question may be determined by a study of the complete 10-year record.

During these ten years (1898–1907) the average annual rainfall at Colon was 121.7 inches, at Gamboa, 87.2 inches, and over the entire basin above Bohio, 107.8 inches; this would suggest that the latter is about 89 per cent of that at Colon, 124 per cent of that at Gamboa, and 52 per cent of the aggregate at the two stations. A test of these coefficients was made by applying them to each of the ten yearly records, and comparing the computed results for the entire basin with the known true values. The probable error for a single result proved to be for a Colon record 9.48 inches (9 per cent), for a Gamboa record 6.32 inches (6 per cent), and for an aggregate record 6.12 inches (6 per cent). Such probable errors are quite within limits when dealing with general rainfall estimations, and the above coefficients have been used in preparing the following table. When records at both stations are available, preference has always been given to the value found by taking 52 per cent of their sum. Indeed this is practically equivalent to adopting the average of the two stations; and their geographical location, as shown above, would suggest that such an average should give a fairly good idea of the downfall over the entire basin, which is what is wanted for the rainfall element. The other data require no explanation. Table 1 presents their analysis.

TABLE 1.—*Rainfall, runoff, and freshets, Isthmus of Panama.*

Year.	Precipitation.		In basin above Bohio.			Freshets at Gamboa.		Remarks.
	Colon.	Gamboa.	Rainfall.	Outflow.		Annual.	Duration.	
	Inches.	*Inches.*	*Inches.*	*Feet-secs.*	*Inches per square mile.*	*No.*	*Hours.*	
1863..	129.8	.....	115	.....	.....	.....	.....	Records of Panama Railroad.
1864..	106.9	.....	95 102	.....	.....	.....	.....	
1865..	107.4	.....	96	.....	.....	.....	.....	
1866..	129.7	.....	115	.....	.....	.....	.....	
1867..	86.3	.....	77 100	.....	.....	.....	.....	
1868..	120.0	.....	107	.....	.....	.....	.....	
1869..	114.8	.....	102	.....	.....	.....	.....	
1870..	149.6	.....	133 105	.....	.....	.....	.....	
1871..	99.6	.....	81	.....	.....	.....	.....	
1872..	168.5	.....	150	.....	.....	.....	.....	
1873..	87.1	.....	78 117	.....	.....	.....	.....	
1874..	137.7	.....	123	.....	.....	.....	.....	
1875..	94.7	.....	84	.....	.....	.....	.....	
1876.	124.5	.....	111 99	.....	.....	.....	.....	22d Ann. Rep. U. S. Geol. Survey, Part IV. Plate.
1877..	115.4	.....	103	.....	.....	.....	.....	
1878..	86.7	.....	77	.....	.....	.....	.....	
1879*.	146.2	.....	130 110	.....	.....	.....	.....	
1880.	136.4	.....	121	.....	.....	.....	.....	
1881..	102.3	89.5	100	.....	.....	.....	.....	Records of the canal.
1882..	124.1	79.6	106 102	.....	.....	21	201	
1883..	115.3	76.6	109	.....	.....	21	201	
1884..	86.5	93.9	93	.....	.....	23	334	
1885*.	146.3	97.5	127 116	.....	.....	37 35	437 403	
1886..	137.2	104.9	125	.....	.....	43	437	
1887..	154.9	136.2	151	.....	.....	46	709	
1888*.	.....	102.6	127 139	.....	.....	29 37	596 653	
1889..	.....	†75.7	.....	.....	.....	.....	.....	Collapse of first French Co. Liquidation.
1890*.	154.3	105.0	135	6,304	122.4	34	308	
1891..	124.7	77.7	105 123	4,476 5,764	86.8 111.8	10 23	116 231	
1892..	145.3	104.4	130	6,513	126.3	24	269	
1893*	131.9	117.8	130	7,081	137.4	12	229	
1894..	153.7	90.6	127 131	6,098 5,887	118.4 114.2	25 15	263 179	
1895..	151.5	.....	135	4,482	86.9	7	54	New French Co.
1896..	131.5	.....	117	4,216	81.8	.....	.....	
1897..	138.0	107.8	128 116	4,830 4,330	93.7 84.0	16 12	157 104	
1898..	115.5	82.6	103	3,944	76.5	8	51	
1899..	133.0	80.0	111	3,384	65.6	8	57	
1900..	116.1	78.7	101 106	3,509 3,583	68.0 69.5	12 11	84 83	
1901..	107.7	91.6	104	3,855	74.8	13	107	
1902..	112.6	97.7	109	4,179	81.1	5	37	
1903..	126.3	99.3	117 112	3,958 4,082	76.7 79.2	12 10	94 75	
1904..	126.9	84.5	110	4,110	79.7	13	94	United States in charge.
1905.	118.4	82.2	103	2,800	54.3	6	48	
1906*.	138.1	97.8	123 111	4,169 3,522	80.9 68.3	12 10	178 98	
1907..	125.6	78.1	106	3,597	69.8	11	69	

* Years of great floods; these are the only ones of record.
† Accuracy doubted.

It should be stated that the rainfall records up to 1903, except for the years 1875 to 1880, as quoted in the table, may be found in the form of monthly means in the MONTHLY WEATHER REVIEW for May, 1899, XXVII, p. 202–203, and March 1903, XXXI, p. 122. They are nearly complete, and fortunately the few months lacking are mostly in the dry season where they have little importance, and can be supplied accurately by interpolation based on months of about the same period. The freshet records are complete except for October, 1887, and August and September, 1897, which have been supplied by averaging those of the two nearest years. The gagings are complete, and to make the volume of the discharge directly comparable with that of the rainfall it is stated in inches per square mile per year as well as in cubic feet per second. In fine the records are essentially complete and trustworthy for the whole period under consideration. To make the progressive changes in the four elements more distinctly visible to the eye the years have been grouped by threes, both in the table and on fig. 1.

An inspection of this table, and of the figure illustrating it (fig. 1), can leave little doubt that during the last forty years there has been a well-marked gradual increase followed by a like decrease in the annual precipitation and in resulting river outflow; that a period not much if any above the minimum is now passing. The maximum epoch, as nearly as can be determined, occurred about twenty years ago when the de Lesseps Company was most actively at work; and at that date the annual rainfall in the basin above Bohio was fully one-quarter greater than the present. This maximum was preceded by a minimum at an interval of about twelve years, when the downfall appears to have differed little from what it is at present. Four different lines of evidence, in recent years, suggest these conclusions, and it may be noted that the figures of rainfall and outflow tend to support each other. Thus the difference between them, representing evaporation, diminishes as the rainfall increases. Direct observation at the Isthmus in 1907 showed that monthly evaporation from exposed water surfaces in the rainy months is only about 60 per cent of what it is in the three dry months; and for the general surface of the country the difference should be even greater. A sensible reduction in evaporation as annual rainfall increases should therefore be anticipated, and this is what the figures show.

In fine, it would seem to be undeniable that long-period progressive variations do occur in the volume of Isthmian rainfall, and that at present a minimum epoch is passing. There are records of similar changes even in regions of moderate annual rainfall; as for example in the Croton Valley watershed, which supplies New York City with water, where during the last half of the 36-year period from 1869 to 1904 the precipitation is reported to have exceeded that in the first half by about 30 per cent. The causes of such variations are certainly an interesting subject for study, and for this the Tropics, where frost is unknown, offer special advantages.

The estimates for the water supply of the canal are based on the minimum measured flow of the Chagres River to date, and it is satisfactory to know that there is good reason to believe that this volume is practically an absolute minimum. Furthermore, from the form of the curve since the last maximum epoch it is reasonable to hope that time enough to complete the work may be available before the advent of the next maximum. Rainfall as great as that upon the Isthmus is a formidable obstacle to rapid prosecution both of excavation and of lock and dam construction.

SEVERE WINDSTORMS IN OHIO, JUNE 19, 1908.

By J. WARREN SMITH, Section Director. Dated Columbus, Ohio, July 14, 1908.

Very severe thundersqualls occurred in most sections of Ohio on the afternoon of June 19. Thunderstorms with high winds were noted in the western counties soon after 2 p. m., while the squalls did not reach the eastern counties until about 6:30 p. m. Their progress across the State is shown in fig. 1.

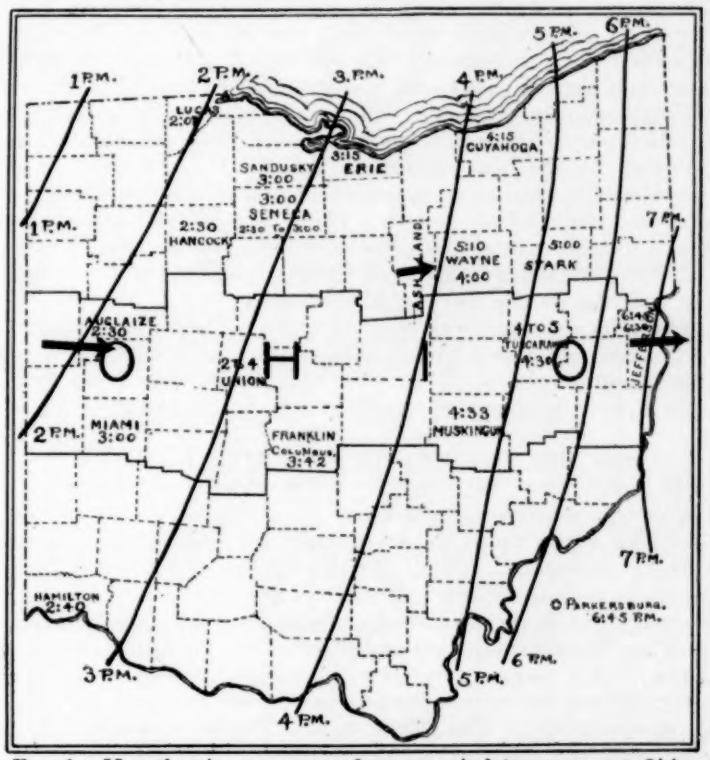

FIG. 1.—Map showing progress of severe windstorms across Ohio, June 19, 1908.

At Indianapolis, Ind., the first thunder was heard at 12:50 p. m. At Sandusky, Ohio, the wind reached a velocity of 26 miles an hour at 3:15 p. m. At Columbus it blew at the rate of 64 miles an hour for three minutes at 3:42 p. m. At Cleveland the highest wind was 52 miles an hour at 4:15 p. m., at Parkersburg, W. Va., 30 miles an hour at 6:45 p. m., and at Pittsburg, Pa., 43 miles an hour at 7:15 p. m.

The damage to fruit and forest trees, fences, telephone and telegraph wires, and buildings was widespread, but from reports received the greatest damage seems to have been in Auglaize, Hancock, Sandusky, Tiffin, Ashland, Wayne, Tuscarawas, and Jefferson counties.

Mr. Jacob Bornbeck, who lived near Canal Winchester in Tuscarawas County, was crushed and killed in the ruins of his barn that was blown down. Quite a number of people were injured in various parts of the State.

Miss Lillian Grothaus of New Bremen reports that a well-defined funnel-shaped tornado cloud, with rotary winds, occurred near Minster, in Auglaize County. The color of the cloud was greenish and yellow. The path of the tornado was about one mile in length and one-half mile in width.

Mr. Martin J. Hoffmann of Loudonville, Ashland County, reports that a tornado past thru the northern part of that place. One building was demolished and other damage was done. The path of greatest damage was about one-half mile in length and about 80 feet in width. Its direction was slightly to the north of east. A typical funnel-shaped cloud was visible and was observed by several people.

A great deal of damage was done in southern Sandusky and northern Seneca counties, but the reports indicate that the wind was a straight-line squall and not a tornado.

Near Wooster, in Wayne County, the horse and buggy with which Dr. W. F. Derr was driving was picked up by the wind, carried across the ditch, and landed bottomside up against the fence. The path of the greatest damage at this place was

about one-half mile wide, but the reports indicate that it was due to a straight-line squall and not to a tornado.

At Steubenville, Jefferson County, three brick buildings were demolished, many buildings unroofed, and the steamer *Queen City*, with fifty passengers aboard, was blown from the wharf. Reports from Steubenville indicate that the damage there was done by a tornado; the loss was estimated to be $30,000.

There seem to have been well-defined funnel-shaped tornado clouds observed in a few instances, and the best defined are indicated by the heavy arrows in fig. 1. It is probable, however, that the wind in most instances was of the thundersquall type or straight-line squall. These winds are always more severe in some places than in others, but the current is broad and they lack the narrow, well-defined path of great destruction that marks the work of the tornado.

Tornadoes occur very rarely in Ohio. They may be known by the funnel-shaped cloud that hangs downward from the mass of clouds above. Wherever this funnel dips down to the earth it usually demolishes everything in its path.

SEVERE WINDSTORM IN SOUTH DAKOTA.

By S. W. GLENN, Section Director. Dated Huron, S. Dak., July 16, 1908.

A severe windstorm, attended by heavy rain and in some places by heavy hail, past southeastward over Brule County, S. Dak., on June 27, 1908. At the village of Pukwana, Brule County, where the storm appears to have attained its maximum intensity, five large business buildings, two churches, and three dwellings were demolished and practically every other building in the village was more or less damaged. A very remarkable feature of the storm was the absence of any fatalities and cases of serious injury. The storm struck Pukwana at about 10:50 p. m., and the destructive wind lasted about one minute and a half. On an extensive ranch adjacent to Pukwana all of the buildings were blown down and some live stock was killed. The storm extended west to Chamberlain and east to Kimball, in the same county, but was much less severe at these places. Because of the late hour when the storm occurred, it is impossible to say whether or not it had the marked peculiarities of a tornado, but a gentleman who visited the place soon afterward describes the arrangement of the débris in such way as to lead to the opinion that it was. The path of the destructive wind was about one-half mile wide. It past south of Kimball, damaging a few buildings and killing some live stock in that portion of the country.

TIDES OF THE SOLID EARTH, OBSERVED BY DOCTOR HECKER.[1]

By R. L. FARIS, Assistant, Coast and Geodetic Survey.
[Read before the Philosophical Society of Washington, May 23, 1908.]

The author's purpose in his paper is to present the most important results of a series of horizontal pendulum observations made for the purpose of studying the disturbances of the plumb-line under the attractive influence of the sun and moon.

The deflections of the plumb-line, as the author states, can be directly brought about in two ways thru the influence of the sun and moon; first by the sun's radiation causing a deformation of the surface of the ground, and thereby a consequent tilting disturbance of the pendulum, but producing no change in the direction of gravity; second, by their attractive effect, producing a deflection of the vertical or change in the direction of gravity.

The first systematic attempt to determine experimentally the lunar disturbance of gravity appears to have been made almost thirty years ago by Prof. G. H. Darwin,[2] at the suggestion of Sir William Thomson. While his experiments with a vertical pendulum apparatus at the surface of the ground lead to no conclusive results, yet he indicates in his report, submitted to the British Association in 1881, the possibility of securing the suitable conditions and instruments "amply sensitive enough for such a purpose."

In the second report upon the same subject, a year later, in 1882,[3] after discussing the amounts of distortion of the earth due to barometric and tidal oscillations, Darwin remarks that, we can not know these data for a 500-mile radius about a station so we can get an approximate idea of the slope of the surface. Even if these data were known the heterogeneity of the geological strata would be an obstacle to correct computation. It was his opinion at that time even "with gravitational instruments of very great delicacy, in the most favorable site, the record would show incessant variations of which no satisfactory account could be given." He, therefore, viewed the problem of experimentally determining the lunar disturbance of gravity as "exceedingly remote." But he adds in conclusion that, "by choosing a site where the flexure of the earth's surface is likely to be great, it is conceivable that a rough estimate might be made of the modulus of elasticity of the upper strata of the earth for 100 or 200 miles from the surface."

A quarter of a century later, in editing the first volume of his collected professional papers, Darwin has added a note to the above report, in which he indicates that in the light of Doctor Hecker's recent work with the horizontal pendulum at Potsdam, he has now reason to change his former view in reference to the instrumental measurements of the lunar disturbance of gravity.

Doctor Hecker bases his conclusions upon a continuous series of pendulum observations extending thru the twenty-eight months from December, 1902, to May, 1905. The pendulums were mounted in a room especially designed for the purpose, at a depth of 25 meters below the surface of the ground. This room, built of brick laid with cement, was connected with the well of the astrophysical observatory at Potsdam. The depth of 25 meters was chosen for the pendulum room in order to avoid the diurnal effect of the sun's radiation and to secure a sand foundation for the pendulum pier. The sand foundation, being less affected by moisture conditions, was also a favorable factor in eliminating the causes producing the apparent deflections of the plumb-line.

It appears from the author's statement that the temperature of the pendulum room remained practically constant at 11.7° centigrade.

The pendulum used was a modified form of von Rebeur's pendulum, consisting of two small brass tubes joined at right angles to form a T, the top being the vertical axis. The upper bearing of the vertical axis was a spherical sapphire of about 2 millimeters radius. The lower bearing was a sapphire plane. These sapphire bearings rested against steel points on the pendulum supports. The horizontal bar of the pendulum carried a 40-gram weight near its outer end. Two such pendulums, at right angles to each other, were mounted in independent supports fastened to a heavy triangular iron bedplate provided with three foot-screws which sat in the footplates upon the pier. The two separate pendulum supports, carrying the two pendulums, rested upon small steel points, two of which were small steel balls fitting into conical holes in the bedplate. The line joining these two points was parallel to the horizontal axis of the pendulum, while the third, also a steel ball, was fastened to the end of a slow-motion screw which past up thru the bedplate. By means of this screw the position of the zero point of the horizontal axis of the pendulum could be adjusted. Adequate means were pro-

[1] Beobachtungen an Horizontal-pendeln über die Deformation des Erdkörpers unter dem Einfluss von Sonne und Mond—von O. Hecker—Veröffentlichung d. k. Preus. Geod. Inst., N. F. No. 32—Berlin, 1907.

[2] Brit. Association Report, York meeting, 1881, pp. 93–126.

[3] British Association Report, 1882, p. 95–119.

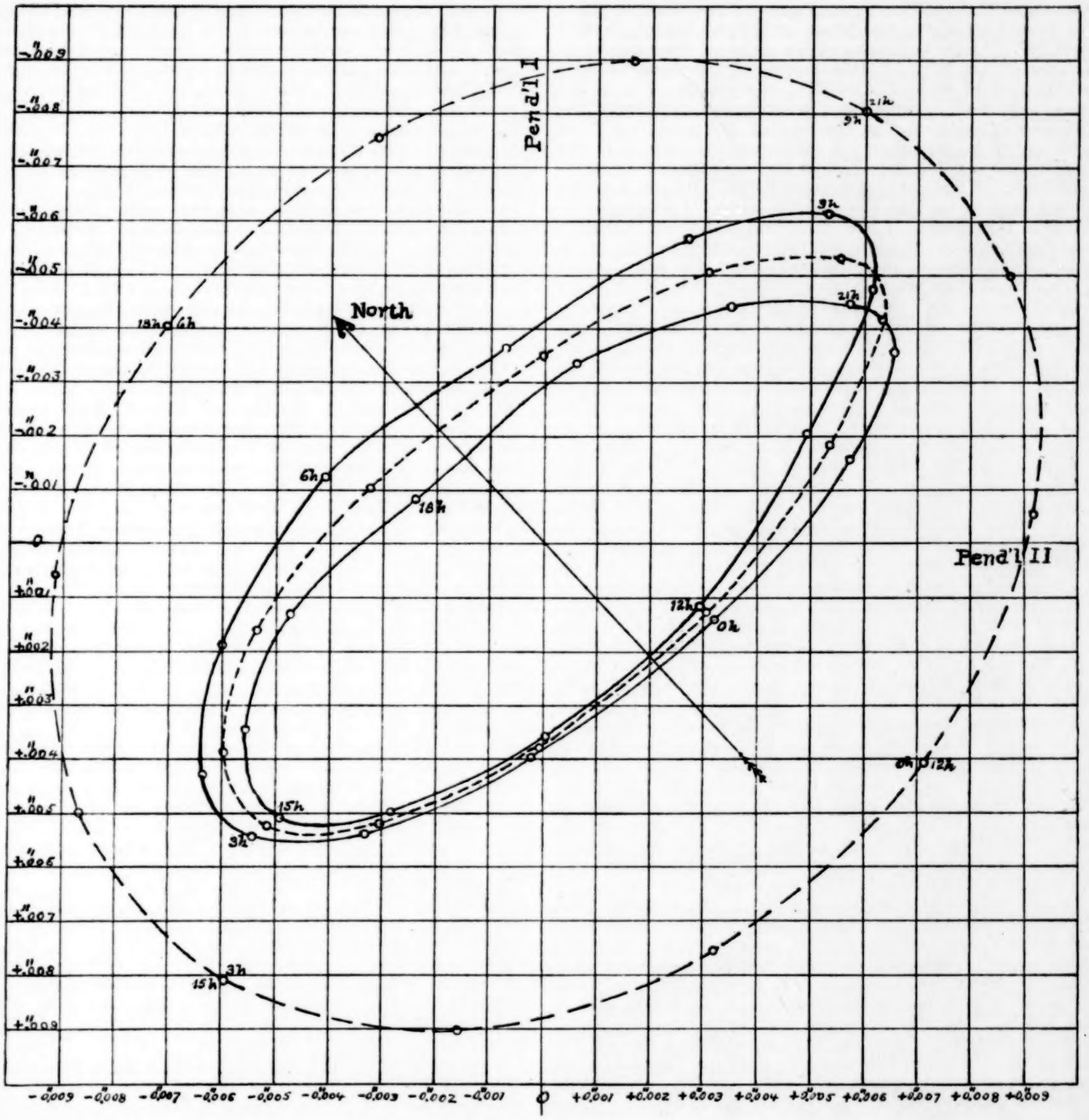

FIG. 1.—The motion of the plumb-line under the influence of the moon. Pendulum I pointed NE.; pendulum II pointed NW. (Reproduced from Veröff. d. k. preuss. Geod. Inst., Berlin ,1907, N. F., No. 32, Taf. VII.)
——— observed motion. - - - - - observed semidiurnal motion. — — — theoretical motion for absolutely rigid earth.

vided to protect the instrument from air currents and the steel suspension points of the pendulum from rusting. From the method of mounting the instrument, only one kind of metal being used, temperature fluctuations would not produce deflections of the pendulums. The pendulum designated as No. I (fig. 1), pointed approximately northeast or parallel to the long way of the room, while No. II was directed approximately northwest.

A continuous record of the position of the pendulum was obtained by the photographic process. The recording device was so arranged that two fixt lines were traced photographically upon the record sheet, one on each side of the pendulum record, so that the shrinkage of the record sheet could be more accurately eliminated. The time scale of the record was 12.5 millimeters per hour, which was amply sufficient for the purpose of the investigations. The recording apparatus was

so arranged that a millimeter on the record sheet corresponded to a movement of the pendulum in the horizontal plane of about 28″. At the beginning of the series of observations, in the case of pendulum I, this movement corresponded to a deflection of the vertical of 0.0356″; at about the close of the series, twenty-six months later, it amounted to 0.0802″ per millimeter of ordinate. In the case of the pendulum II at right angles to pendulum I a corresponding change in the sensitiveness is noted, for which at the beginning of the series a millimeter of ordinate represented 0.0201″ deflection of the vertical, while near the close of the series it amounted to 0.0622″. It is thus seen that there was a very wide range in numerical value of the reduction factors, which for the whole period of the observations amounted to from two and one-half to three times their original value. While the author has not definitely ascertained the cause of this persistent decrease in the sensitiveness of the pendulums, yet he has stated his reasons for believing that it was not brought about by the wearing down of the steel suspension points, nor due to the inclination of the whole apparatus, but concludes that the cause must be inherent in the suspension of the pendulum upon points. He remarks in this connection that the decrease in the periods of the pendulum is unimportant, since the periods can be ascertained between the observed values with sufficient accuracy. However, it seems to me that the decrease in the periods of the pendulums as well as the shifting of the zero points is due to a gradual tilting of the pier to the northward. The effect of the shifting of the zero point was eliminated from the results by a method previously employed by von Rebeur,[4] in which it is assumed that the irregularity of the movement of the zero point is practically eliminated by dealing with the monthly means of each hour. From the monthly means of the hourly values correction coefficients were derived by which these mean values could be corrected for the gradual shifting of the zero point. Pendulum No. II, which was parallel to the shorter dimension of the room and directed toward the northwest, showed the greater irregularity in the motion of the zero point, and its total shift during the series of observations was about three times as much as for pendulum I, which was parallel to the longer side of the room. This change of the zero point of both pendulums appears to have arisen from the gradual sinking of the well, the masonry walls of which were in direct masonry contact with the pendulum room, thereby causing a tilting of the pendulum room and pier in a direction approximately toward the well.

In deriving the amplitude and phase of the periodic effect of the moon upon the pendulum the observations were divided into lunar months, thirty months being obtained from the whole series of observations. The monthly means for each hour were then combined into four groups, the first three groups each containing seven months and the fourth having nine months. A fifth group was also formed for the entire series of thirty lunar months. An expression is derived for each of the five groups in terms of a trigonometrical series and involving a daily, a half-daily, and a quarter-daily period.[5]

For the whole series of observations the following expression results for pendulum I, viz:

$$0.00057'' \cos (t-267.7°)+0.00622'' \cos (2t-285.3°)+0.00016'' \cos (4t-173.8°).$$

Comparing the four similar expressions as derived from the four sections into which the series of observations was divided, it is seen that the coefficients of the daily and quarter-daily terms are quite small, and also that there is a wide range in the phase. Owing to the small magnitudes of the coefficients of these terms they can be considered negligible. But in the case of the half-daily term the coefficients and the phases show a good agreement; the resulting expression is, therefore, $0.00622'' \cos (2t-285.3°)$, which clearly indicates the existence of the tide-generating force of the moon.

If we now compare the magnitude of this observed value with the computed value of the deflection of the vertical upon the assumption of an absolutely rigid earth, we should get definite indications of the earth's actual rigidity.

For computing the deflections of the vertical for an absolutely rigid earth the formula recently derived by Scheyder[6] was employed. By this formula the expression for the computed deflection is, for pendulum I, $0.00922'' \cos (2t-305.5°)$. Comparing this expression with that derived from the pendulum observations it is seen that the observed deflection of the plumb-line, as caused by the moon's attraction, is about two-thirds of what it would be for an absolutely rigid earth; according to these observations the earth has about the same rigidity as a sphere of steel of like dimensions.

The observations are also discust with reference to the sun's effect in deflecting the vertical. The same methods were applied as in the case of the derivation of the moon's effect, except that the observations were grouped into calendar months. From the monthly means for each hour were derived the corresponding yearly means which were used in the trigonometric series to obtain the expression representing the observed effect due to the sun. The expression thus derived for pendulum I indicates that its motion under the sun's attraction consists of a daily oscillation upon which is superimposed a semidiurnal wave. The semidiurnal term is considered certainly to be due to the sun's attraction for the reason that there is a good accordance in this term as computed separately for each month, and its phase is about the same as that of the semidiurnal term derived for the moon. The observed semidiurnal term is $0.00244'' \cos (2t-277.5°)$ for pendulum I.

For an absolutely rigid earth the computed sun's attraction is $0.00399'' \cos (2t-305.5°)$ which is about in the same ratio to the observed value as was found in the case of the moon. In the case of pendulum II the coefficient of the observed semidiurnal term is too great, as it is in excess of that computed for an absolutely rigid earth. The observed and computed phase in that term are almost identical.

In the case of the measurement of the deflection of the plumb-line due to the sun's attraction two essentially greater difficulties are met with than in the case of the measurement of the moon's effect. First, the magnitude of the disturbance is only about half so great as for the moon, and the second and greater difficulty is due to the sun's radiation upon the surface of the ground, the effect of which is to cause a periodic fluctuation of the pendulum which may amount to many times the gravitational effect of the sun.

In the report of the British Association for the Advancement of Science for 1881 Prof. G. H. Darwin,[7] after reviewing his own experiments in the investigation of the lunar disturbance of gravity and the reports of others, states that "there can be little doubt that the surface of the earth is in incessant movement, with oscillations of periods extending from a fraction of a second to a year." By special experiments he also found the surface of the ground "to be in a state of continual vertical oscillation."

Hecker's installation of pendulums at a depth of 25 meters below ground, and on a sand foundation, reduced the effect of the sun's radiation to about one-seventh of the surface disturbance, and practically secured a constant temperature.

[4] E. von Rebeur-Paschwitz, Horizontal-pendel Beobachtungen auf der K. Universitäts zu Strassburg. Beiträge zur Geophysik, Band II, Stuttgart, 1895, p. 245.

[5] Trigonometrical Series. "Die Ausgleichungsrechnung nach der Methode der Kleinsten Quadrate." F. R. Halmert, Leipsic, 1907, pp. 403, et seq.

[6] Beiträge zur Geophysik, Bd. IX, Heft I, pp. 41–77—"Ein Beitrag zur Bestimmung des Starrheitskoefficienten der Erde"—Wilhelm Scheyder.

[7] British Association Report, York meeting, 1881; p. 93–126.

As a final result the pendulum observations clearly show the tide-producing influence of the sun and moon upon the solid earth.

If we now compare the observed deflections with the values computed for an absolutely rigid earth, it is seen that the observed deflection due to the moon is about two-thirds of the amount for the rigid earth. If the earth were an absolutely nonrigid, homogeneous body, a change in the equipotential surface would result from the deformation of the surface shell produced by the sun's and moon's attraction, and consequently no movement of the pendulum would thereby be produced.

The effect upon the pendulum of the tides in the North Sea, the nearest body of water to Potsdam having appreciable tides, is computed to be 0.0006″ for a range of 1 meter in the sea level. As far as known, the nature of the North Sea tides is such as to decrease the above figure; their effect upon the pendulum may therefore be considered negligible. From all that is now known of the Atlantic Ocean tides, their effect upon the pendulum, as the author states, must be very small. The observations clearly yield evidence that, as the author states, "the solid earth does yield somewhat under the influence of the sun's and moon's attraction, yet offers great resistance to deformation."

The observations were analyzed with reference to the existence of a movement of the pendulum corresponding to the sidereal day; but no definite result was reached, except that, if such an effect exists, it must be very small, or, in other words, not measurable.

This series of observations has yielded evidence in good accord with that indicated from other directions, and when we consider the small magnitude of the measured quantities there is sufficient proof of the thoroness with which the observational work has been executed.

While it is not claimed that the results derived from this series of observations give an exact measure of the earth's actual rigidity, yet they do yield values based upon a direct measurement that must be considered a splendid approximation of the truth, and we are justified in believing that a great step forward has been made in thus definitely adding to our knowledge of an important physical fact.

SOME CLIMATIC INFLUENCES IN AMERICAN HISTORY.[1]

By WALTER N. LACY. Dated Cambridge, Mass., June 26, 1908.

"Of all natural forces influencing the life of a nation," says Prof. Edward Channing (2, p. 2), "the climate and rainfall are the most important, because an excess of cold or an absence of rain forbids the development of human activity." In connection with recent studies, the writer has had occasion to note some of these climatic influences in the history of the United States and this paper is an attempt to present some of these influences without chronologically considering the possible climatic controls in every chapter of American history.

Climate is complex and controlled by many factors. Hence, the fact must be borne in mind that whatever influence it has had upon the life of a people, it has not acted independently. Geographic and other factors enter into the controls of history to such an extent that even where any one of them has had an important influence, to it can rarely be attributed the whole cause of the events which have been so vitally affected thereby. The influence of those climatic controls on the history of a nation is, perhaps, too seldom considered, important tho these controls are. It is, therefore, the hope of the writer that this paper may lead to a wider appreciation of climatic influence on history.

[1] A thesis prepared in 1908, under direction of Prof. R. De C. Ward, for an advanced course in climatology at Harvard University.

References to the numbered bibliography are given in the parentheses by heavy-faced numbers.

DISCOVERY.

Why not earlier.—Whether the American Indian came originally from China or Japan is a question which the historian still leaves to the archeologist. It seems certain, however, that if he did come from Asia, all communication between the American and his Asiatic brother was subsequently terminated. When Columbus first saw the New World in 1492, it was an unknown world—neither Europeans nor Asiatics knew of its existence. Why, it is then natural to ask, had the American Continent not been discovered and made known before? This question seems especially pertinent in view of the close mutual approach of these continental masses at the north. The answer lies, doubtless, in the fact that this proximity was found only at these high latitudes. Had it not been for the rigorous climate which exists along the northeastern coasts of Asia and North America, it seems probable, if not certain, that America would have been known to the rest of the world some centuries prior to the fifteenth. Those were the days when ignorance and superstition, coupled with unseaworthy ships, prevented the mariner from venturing far from the shore; hence, to discover America from either Europe or Asia was possible only by cruising along the coasts, and crossing from one continent to the other where the two most closely approach each other. This was prevented by the hostile climate which had to be encountered, for food supplies could not be secured on these inhospitable coasts. As Professor Shaler has pointed out (13, p. 6), "the scanty food-carrying power of the ancient ships, whether of Europe or Asia, made it almost impossible for an expedition to pass from the Old World to the New World by coasting along the arctic shores, and thus to attain the fertile lands of America in a condition to meet the dangers which newcomers have to face in an unknown land." Under these conditions, had the continent been discovered by Europeans or Asiatics, the discovery could not have been followed by settlement, and the fact of the discovery would probably have been forgotten.

The Northmen.—While it is doubtless true that America was an unknown continent in the fifteenth century, nevertheless, Columbus can not lay claim to the honor of being the first white man to see its shores. Here, again, climatic influences have played an important part. Climatic and other geographic conditions had made the people of Scandinavia a sea-faring people. A thousand years ago Iceland was a European colony, and a settlement had been planted near the southern end of Greenland. Ivar Bardsen, steward of the Garder Bishopric in the latter half of the fourteenth century, recorded that there had been a gradual southward extension of drifting ice and of the Greenland ice-cap, and the fact that "herds of cattle were kept which even yielded produce for exportation to Europe," (quoted in 6), has further led to the conclusion that Cape Farewell had a slightly milder climate a thousand years ago than it has to-day. But whether or not this was the case, it seems certain that a colony of Northmen flourished for a time near this place.

"With the Northmen once in Greenland, the discovery of the American Continent was almost inevitable" (6, p. 178). However mild the climate of Greenland may have been, the land does not seem to have been well-wooded, and Laing has pointed out how natural it was that the colonists there should seek the abundant and cheap fuel supply which the driftwood, floating from the southwest, indicated was to be found in that direction. With the prevailing westerly winds and the Gulf Stream, it is highly probable that driftwood from the American forests was floated across the sailing route between Greenland, Iceland, and Scandinavia, and in quest of this lumber the Northmen may have ventured. Or a storm, setting in fiercely from the northeast, would easily have driven these bold sailors from their courses, and landed them on the western coast of the Atlantic.

But whatever the cause, weather influences were important, and it seems reasonably certain that this continent was visited by the Northmen as early as the year 1000. Ridpath (9, p. 51), tells us that the continent was first seen by whites in the year 986, when "Herjulfson, sailing from Iceland to Greenland, was caught in a storm and driven westward to Newfoundland or Labrador;" but he adds that "no landing was made or attempted." Channing believes that there is "little doubt that Lief Ericson was the first Northman to see Vinland, and that he made his voyage in the year 1000, or just before." (2, p. 20). Precisely who did make the first discovery, and when it was made, are not matters of great importance in the question under consideration; the importance of the matter for us lies in the fact that the discovery was not followed up by settlements, and the continent proper was not made known to the Old World. The location of Vinland is still an unsolved problem, but these Northmen seem to have found a land where the climate was unpleasant and even, doubtless, harsh, and hence any attempts at colonization, if made, were early abandoned.

Why discovered.—Why the New World was discovered at the time and in the manner in which it was, is a problem as interesting as, and perhaps more important than the one just considered. Europe had long carried on an extensive trade with eastern Asia, and any interruption to that trade would necessarily be an important factor in European life. This trade was carried on by boat and caravan across Egypt, or thru western and central Asia, to the rich markets of India, China, and the East Indies. The rise of the Saracen power in the seventh and eighth centuries, the later invasion of the Seljukian Turks, and the capture of Constantinople in 1453, closed the three trade routes from Europe, and necessitated the establishment of a new route to the East. Hence, there appeared in southern Europe in the late fifteenth century a few men who believed that a sea route to the eastern markets was possible, either westward, circumnavigating the earth, which some now believed to be a sphere, or southward around the unknown extension of the African Continent.

The conception of climatic zones.—Few minds were willing to forsake the old idea that the earth is a plane, and hence the route around Africa seemed perhaps the more logical, altho even to this insuperable difficulties seemed to present themselves. The Mediterranean was the center of human activity and intellectual advance. The people living in this basin were acustomed to the cold northerly breezes and knew by report something of the frigid conditions in the far north, while on the other hand they had perhaps too often experienced the hot blasts which swept north from the Sahara Desert.

Hence, they naturally conceived the idea that "in the extreme north the country must be frozen and the country uninhabitable by reason of the cold; contrariwise, in the far south the ocean must be boiling hot and the country inhabitable only by gnomes and salamanders." (6, p. 306.) To circumnavigate Africa would necessitate a voyage thru these boiling seas, and so men turned their attention to the possibilities of the westward route.

Christopher Columbus had spent some time during the years 1474–1480 in writing a treatise on "the five habitable zones," with the purpose of refuting the conceptions of uninhabitable climatic belts. It is evident, therefore, that he did not hold the ideas then prevalent concerning the circumnavigation of Africa; but being possest of a somewhat more advanced belief in the rotundity of the earth than was held by most of his contemporaries, and vastly underestimating the size of the globe, Columbus was the first who actually set out to seek the East by sailing westward.

Winds and currents.—If erroneous conceptions of climatic belts delayed the discovery of the southern passage, on the other hand meteorological conditions favored the attempt to find the western route. Spanish and Portuguese navigators had been sailing between their home ports and the Cape Verde Islands for about fifty years, and it is probable that Columbus had learned from them something of the northeast winds that blow so steadily in those latitudes. Setting sail from Cadiz on August 3, 1492, Columbus took advantage of the northeast trade winds and dropt down to the Canary Islands. In this latitude these winds blow from an almost easterly direction in September, and the ocean currents, largely controlled by the atmospheric circulation, flow in a westerly direction. With these aids to navigation, the daring explorer sailed from the Canaries just a month after leaving Cadiz, and was wafted westward until he reached one of the islands off the southeast coast of North America. Had Columbus sailed from the vicinity of the British Channel, comments Professor Shaler (11, p. 191), the prevailing westerlies "would probably have insured the failure of his adventurous voyage." The meteorological conditions of the North Atlantic Ocean not only determined the part of the world to which Columbus was to come, but actually made possible, it seems, the discovery of America by Europeans at that time.

Cabot's failure.—Knowing that land could be reached by sailing westward, John Cabot, setting out from Bristol, England, in 1497, was not deterred by the head winds which he had to encounter in his effort to reach the New World. But climatic conditions put the stamp of failure on his expedition. He landed not on the balmy shores to which his predecessor had come, but on the less attractive shores of Cape Breton Island (or at some other point between Labrador and Cape Cod), where he found a harsh and inhospitable climate, far different from and much more severe than that which he had expected.

Thus it is seen that meteorological conditions have been important factors in the discovery of North America. These conditions helped to keep the New World unknown until trade with Asia necessitated the discovery of a new route; they favored the attempt to find a western rather than a southern route; they made possible the voyage of Columbus and determined his arrival at a part of the world where the climate was attractive and favorable for exploration and settlement; and they resulted in the failure of Cabot's voyage, thus determining the early settlement of the tropical portion of the continent.

EARLY SETTLEMENT.

The settlement and colonization of what is now the United States did not commence until nearly a century had elapsed after the first voyage of Columbus. The Spaniards had been the first to find the New World, and not mere chance had brought them to the tropical and semitropical parts of that world. To these, during the century that had past, their attention had been confined, while the vast rich areas farther north remained almost unknown, so that these regions were left to the French, the English, and the Dutch—people more capable of developing themselves and the country than those who had come from the warm and sunny land of Spain.

The Spaniards' position.—The Spaniards remained south of the thirtieth parallel of north latitude for several reasons. Columbus had followed, and had shown to those who followed him the easy route westward in the belt of the trade winds, which brought them directly to the tropical regions of the New World. The return route from this American mediterranean was almost as favorable, for sailing slightly north of the westward course Spanish vessels could be carried eastward in the southernmost part of the belt of prevailing westerlies and reach their home ports by a short cruise southward along the coast of Portugal. Again, Spain, as the first to come to the New World and the first to attempt colonization here, naturally chose for her colonies those regions which were most pleasing. Coming from a semitropical land where they had not needed to overcome the rigors of a severe climate,

these people selected for settlement lands where the climate was even more genial and the soil more productive than in those they had left; here, except for the hostility of the savages, life would be fairly free from toil and care, and thus well suited to the Spanish nature. Finally, the tropical regions of America remained in Spanish hands because the other nations had been excluded from these parts to some extent by a papal bull, "and even more effectively * * * by the currents of the air and sea" (11, p. 191), which, sweeping northward along the coast, confined the English and French to the more northern shores after they had once gained a foothold there.

The French in Canada.—The St. Lawrence River proved to be the gate of entrance to America for the French. In an important way the history of these people in America is largely the result of climatic factors. In her admirable book (10, p. 26) on the geographic conditions of American history, Miss Semple says of the land to which the French came: "The glaciated soil of eastern Canada could promise no great fertility, its bleak climate no luxuriant vegetation; but there was money in peltries." And she further points out the fact that the furs, which the Canadian climate made possible, formed the all-important product which could furnish the large profits necessary for the survival of an infant colony. This very factor not only greatly helped the French colonies in America, but also determined in large measure the nature of those colonies. The soil barred agricultural communities, geographical conditions prevented the development of manufacturing cities such as sprang up in New England. Their trade led the trapper and the hunter far to the west and the south, and they founded small scattered settlements over wide tracts of the country, thus hastening the exploitation of the great interior of North America.

In these facts lies much of France's failure to develop her American possessions. It has frequently been said that "in unity there is strength." The weakness of Canada lay partly in this lack of unity of sentiment, purpose, and settlement; a sparsely populated country, with its few inhabitants widely scattered and ever on the move, is not one likely to possess the elements of strength. Furthermore, a country to be self-supporting, must be able to produce its own agricultural necessities, and this, it has been pointed out, Canada was unable to do. Hence, the colonists had to depend on the mother country, and it was often difficult to maintain the close connection which would be necessary if the growth of the colony were to be healthy and progressive. Mr. Thwaites (15, p. 125) has exprest this difficulty, with special reference to the centering of the colony at Quebec, in these words: "The entrance to the Gulf of St. Lawrence is so far northward that storms and ice floes endanger navigation during half of the year. Colonial possessions over seas can not be maintained unless the mother country possesses the means of easy and frequent communication with them."

Virginia.—The first permanent English settlement in America was made at Jamestown in 1607. The causes which led to the settlement of Virginia were numerous, but among them climatic influences were not lacking.

Eggleston (17, p. 75), has pointed out the fact that "the only maxim of political economy accepted in that day was that a nation was enriched by getting money from abroad and keeping it at home." Following this maxim, it was to the advantage of Great Britain to own possessions which could furnish her with those products for which she had been sending to Mediterranean and Scandinavian ports. Such products could not be raised in the British Isles, and from the first, it has been claimed, there was the hope that the climate of Virginia was sufficiently mild to allow the production of those things which the English had had to import from the Mediterranean Basin. Moreover, there were forests in Virginia which rivalled those of Scandinavia, and if lumber, in addition to the more tropical products, could be obtained, Great Britain could maintain herself independently of the rest of Europe.

However this hope may have stimulated the early settlement of Virginia, it was never fully realized, for the climatic conditions were not all that had been hoped. We are told (16, p. 794), that "there were some English people, who after they had understood the calmness of the Climate, and goodness of the Soyle, did upon the instigation of some Gentlemen of England, voluntarily offer themselves, even with their wives and children, to go into those parts to inhabite." But the climate was not as mild, perhaps, as these people had been led to believe, for in "An Account of Virginia" written in 1618, (14, p. 202, 203), we find the following description of the climate and its effects upon the early settlers:

> The sommer here is hot as in Spaine, the winter cold as in Fraunce or England; the heate of the sommer is in June, July, and August, but commonly the cool breezes asswage the vehemencey of the heat; the chief of winter is half December, January, February, and half March.
>
> The temperature of this country doth well agree with the English constitucions, being sometimes seasoned in the same, which hath appeared unto us by this, that, albeyt, by many occasions, ill lodging at the first * * *, hard fare, and their owne judgements and safeties instructing them to worke hard in the fainte tyme of sommer, (the better to be accommodated and fitted for the wynter,) they have fallen sick, yet have they recovered agayne.

The early settlers in Virginia were largely those whose training had been toward a life generally free from manual labor, for a large part of the population of that colony during the first half century of its history were "gentlemen." As climatic conditions had attracted the easy-going Spaniard to the tropical parts of the New World, so, doubtless, the same influence had induced the English gentlemen to settle in the genial land of Virginia. Once settled here, where the soil and the climate alike combined to favor considerable agricultural holdings, the settlers were scattered on large estates, and the "landed aristocracy" retained the characteristic temperament of the English gentleman. Hence, when colonial history closes, we find a widely scattered population in Virginia settled on large estates, with little concentration in cities; and what was true of Virginia was true in a large way also of Maryland, Georgia, and the Carolinas.

Delayed English settlement in the North.—Our climate becomes more and more rigorous from Chesapeake Bay northward, and we find that successful settlements by the English were not made as early as on the more southern parts of the American coast. Several early attempts at settlement proved failures: such were the voyages of the Cabots, already referred to; such was the attempted colony on the Sagadahoc River, made in the same year that Jamestown was settled. One reason for these and other failures in these parts has been suggested by Professor Channing, who attributes it partly to the fact that the early explorations were made in the summer when the climatic differences between Europe and America were at a minimum, leading the explorers to carry home extremely favorable reports. Colonists coming later had to experience the unforeseen severities of the New England winter, which so disheartened them that they abandoned their new home and returned to England.

Sagadahoc.—The failure of the colony on the Sagadahoc is best described by Grahame (7, p. 159), who says: "The winter proved extremely severe, and confined this small remnant[1] to their miserable dwelling and a helpless contemplation of the dreary waste that surrounded it." Several colonists died during this winter. Supplies came in the spring, but with them news that Chief Justice Popham and Sir John Gilbert, the most powerful patrons of this Plymouth Company Colony,

[1] All but 45 of the original 100 had already returned to England because of the barrenness of the region.—*W. N. L.*

had died. "Their resolution was completely subdued by so many misfortunes," continues Grahame, "and unanimously exclaiming against longer continuance in those dismal scenes, they forsook the settlement and returned to their native land, which they filled with the most disheartening accounts of the soil and climate of Northern Virginia" (in what is now a part of Maine).

Why the Pilgrims landed at Plymouth.—The first permanent English settlement north of Maryland was made by the Pilgrims at Plymouth, Mass., in 1620. Religious conditions in England had inspired these people with the purpose of going to America, where they could believe as they wisht; meteorological factors determined the planting of the colony on the shores of Massachusetts Bay. Sailing from Plymouth, England, the Pilgrims intended to found their new home near the mouth of the Hudson River. For sixty-three days their little craft was buffeted about by the winds and waves, and the storms so far carried them from their course that the first land sighted was Cape Cod. Even then, perhaps, their original purpose might have been effected had not a "contrary wind" driven them back in their further effort to reach the Hudson.

Delayed by accidents when they first sailed from England, and turned from their original destination, these Pilgrims landed at a time and place when the elements of the climate were decidedly against them. The first winter may have been unusually mild, since some of the settlers appear to have written (8, p. 40) that it was "as severe as that of England." But whether that first winter on the shores of Massachusetts Bay was unusually mild or not, it was certainly too severe for the sturdy band who were unprepared for its severities, and "if an early spring had not brought relief, the colony must have perished to a man" (9, p. 91), for already the winter had swept off half the population of the infant colony. But "out of the snows of winter, the desolation of disease, and the terrors of death, the faith of the Puritan had come forth triumphant" (9, p. 123).

Here it may be in order to note that the maintenance and development of a strong colony on this northern shore was possible chiefly because of the character of the colonists who settled there. Had the easy-going colonists of Virginia settled on the shores of Massachusetts Bay, the history of that settlement might have simulated that of the colony on the Sagadahoc River. On the other hand, what would have been the history of Virginia, and what the character of their descendents had the Pilgrims and Puritans landed on the shores of the James or the Rappahannock?

John Smith's attempt.—Before the *Mayflower* sailed for America John Smith had planned a colony in New England, but his plans were overthrown. The third and last time that he tried to carry out his designs, meteorological factors intervened, for the steady blowing of westerly winds kept him at Plymouth, England, for three months, when he finally abandoned his project. This delay probably gave New England a history far different from what it might have had had John Smith been the one to plant the first colony on its shores.

CLIMATE AND THE CIVIL WAR.

The civil war marks one of the crises in the history of the United States, and to no slight degree it was the result of climatic controls. The immediate ostensible cause of the conflict between the North and the South was the question of States' rights, but this was the outgrowth of another, which had for years been a national question of grave importance, i. e., the right to hold human beings in slavery.

"Fundamentally, slavery was the result of greed and selfishness" (3, p. 5, note). But Mrs. Dixon adds: "There is certainly nothing to indicate that human selfishness was more lacking in the North than in the South, and there was necessarily a stronger reason than any moral one which made a sectional line of demarcation between slave and free territory." While the difference between the religious views of the North and those of the South was probably an important factor, yet it is impossible to agree with the sentiment of an English writer who, just prior to the outbreak of the civil war, wrote: "We must look for the cause of the early abolition of slavery in the North to religion alone" (5, p. 10).

Climate and the early settlers.—The influence of climate on the early settlement of New England and the South has already been noted. To the South, it has been seen, came the English gentleman, fond of enjoyment, but unaccustomed to a life of strenuous labor; to New England came the sturdy Puritan, seeking freedom of conscience, and prepared by his serious reflective life for some of the hardships of his new environment. Other factors had helped to bring about this difference between the colonies of the Atlantic seaboard, but the difference which first existed between the Pilgrim father and the Georgian planter was fostered and intensified by climatic and geographic factors. The mountain chain which extends parallel to the coast line, and which is broken by only a few difficult passes, confined the colonists for a century to the narrow belt along the Atlantic. This region, extending thru nearly twelve degrees of latitude, afforded a variety of climate which made possible every industry from the fur trading and ship building of the Hudson and Merrimac rivers to the production of rice and cotton on the lowlands of Carolina. This difference in human employments and interests, produced and perpetuated by the climatic differences, accounts in a considerable degree for the diversity of sentiment and character which later divided the North and the South.

Need of negroes in the South.—When the southern planters found that rice could be cultivated in the swamp lands of their territory, it became necessary to find laborers who could work with immunity in the hot and malarial districts, and the success with which the few negroes who had been introduced into the colonies from Africa had been used at once created a demand for more African slaves. Mr. Gregg tells us (8, p. 350) that "none but negroes could have cultivated the rice swamps of South Carolina; negroes only were fit for outdoor labor thruout the year upon the low-lying, fertile coast lands of the South Atlantic and Gulf States, or in the lower valley of the Mississippi," and soon all the manual labor in the rice, tobacco, sugar, and cotton fields of the Southern States was performed by negro slaves. The idea of employing these negroes as free men was scarcely considered until years later, when the institution of slavery had become well fixt in the country, for "negro labor in such climates had always depended on, been made available, and managed by slavery." (Ibid).

Slavery in the North.—Slavery had existed in the North, but had proved far less profitable than in the South, and it had early been abolished. The climate north of the Ohio and Potomac rivers precluded the cultivation of those products for which the services of the negro were most valuable, while on the other hand its severity compelled everyone to lead an active life for his own comfort. Furthermore, only a few negroes are fitted to work in the northern climate, since it seems to be only after years of acclimatization in America that some have been able to adjust themselves to life in the Northern States. In support of this fact, Mrs. Dixon (3, p. 5, note), has called attention to the difference between the "just-arrived Dahomey negroes who sat shivering in mid-summer at the World's Fair in Chicago, 1893, and the acclimatized negro who has been spreading himself north so regardless of climate."

Climatic sections.—The differences which the climate had helped to produce in the character and occupations of the colonists were perpetuated after the colonies became States; and with the western expansion of the nation, the same sentiments and characteristics were carried along the parallels of latitude.

By 1858 the controversy over slavery had become acute and Abraham Lincoln voiced the sentiments of many when he said, "I believe this Government can not endure permanently half slave and half free. I do not expect that the house will fall, but I expect that it will cease to be divided. It will become all one thing or all the other."

GENERAL CLIMATIC INFLUENCES IN NATIONAL DEVELOPMENT.

What the United States is to-day, she is to a considerable degree because of climatic control. Not only is this true because of the influence of meteorological factors on special events of importance in the history of the nation, but also because of the effect of the climate on the country as a whole. Two of these climatic influences on the development of the country may be mentioned in concluding this paper. "The strength of England," says Professor Shaler (11, p. 119), "and of the English race in North America, the dominance in the world of that peculiar kind of man, depends upon coal." Since that is the case, the strength of the American people and the power of the United States in the world are due in a large way to those climatic conditions which prevailed in North America during Carboniferous times.

But this strength and dominance are due as much to the climate which prevails over the same region to-day. The greatest nations in the world's history have lived between the hot and moist tropical belt and the cold and sterile frigid regions of the Northern Hemisphere. Within this belt lies the United States, extending far enough south to be favored with semitropical products, yet stretching to the north sufficiently far to allow her sons to develop strength in the invigorating climate which makes them energetic men.

The following extracts from the introduction to a book on Weather Influences[3] may serve to present another viewpoint:

> It would seem that in general authors attributed to the meteorological climate, properly so called, influences that are probably due to entirely different matters. For instance, the intelligence, industry, frugality, and humanity of the New England people, the enterprise of New York and Pennsylvania, the haughty bearing of the Southern people, are all of them characteristics that marked the ancestors of these same people when they were living under the same climate in their European homes three hundred years ago, and when they migrated from Asia thousands of years earlier still. It simply happened that political and social conditions in England and Holland led to the settlement of three different American colonies by three different classes of the emigrants, and we have no evidence whatever that the slight differences between the climates of Massachusetts, New York, Virginia, Pennsylvania, and Tennessee have had any appreciable influence in either forming or fixing these traits of character.[4]
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> * * * * * * *
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> The restless, ambitious men and women are in the minority even among enterprising nations. They are said to be especially numerous in the New England States, but this we think is principally a result of the fact that our ancestors were restless migrants, and is only partially the result of the severe climate of that region which killed off a large proportion of the early settlers and forces the remainder to live strenuous lives as the essential condition of existence. Agriculture is the principal labor of man, but where his labors are poorly rewarded he, and especially his children, inevitably seek for more favored regions. The mental and physical activities that are absolutely necessary in such climates as that of Great Britain, Canada, and the United States are not likely to develop a class of drones and are not consistent therewith.[5]
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> * * * * * * *
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> We have good foundation for the belief that a race may develop as well in one portion of the globe as in another so far as climate is concerned, after it has once become acclimated. The period over which our most accurate history and observation extends is too short to justify us in anything more than the recognition of the fact that at the present time dominant races are scattered around the North Temperate Zone, some of them in cold, dry, others in warm, moist climates, some in equable, and others in variable climates, and that they hold power over other tribes both in temperate and tropic zones by the power of their guns and powder rather than by any physical superiority; their intellectual development has been essentially the result of breeding and the building up of families by great attention to genealogies. Their motto has been, "Blood will tell." We must not attribute to climate that which is more likely to be due to inheritance, but having allowed for the latter influence, we may then search among the outstanding discrepancies for that which is properly due to weather and climate.[6]

[3] Weather Influences. E. G. Dexter, with an Introduction by Cleveland Abbe. New York, The Macmillan Co., 1904.

[4] Ibid, p. xii–xiii.

[5] Ibid, p. xv.

[6] Ibid, p. xxx.

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DAMAGE BY FROST AT MIDDLEBRANCH, OHIO.

The following letters from the cooperative observer at New Berlin, Ohio, describe some peculiar features of the damage done by frost at Middlebranch, Ohio, on the night of June 15, 1908:

NEW BERLIN, OHIO, *June 20, 1908.*

MR. J. WARREN SMITH,
Local Office, Weather Bureau, Columbus, Ohio.

DEAR SIR: You are aware ere this that on the night of 15th instant, or last Tuesday morning, there was frost in Ohio in places. Seemingly in my immediate vicinity not very much damage resulted, except that wheat, if injured, will probably show up at threshing time. The mini-

mum thermometer here was 36° and grass and plantain leaves were frosted stiff, also asparagus was hurt some; beans, muskmelon, cucumber, and other garden truck were not injured whatever. But 4 miles east of my place, on the farm of Ed. S. Correll just west of the village of Middle Branch, a strange phenomenon occurred.

In a field of corn, about 6 inches high, two rows of corn around the outside of the field were practically destroyed by the frost; rest of field not injured. There is an old worm rail fence on the east side of the field and near this frost was worst; there is no fence on one side adjoining the oats; on another side a picket fence; the other a wire fence. Besides, across the road from this, were sixteen rows of corn about 18 inches high. This was frozen so it has become bleached, and whether it will recover is hard to tell until later. On this farm the thermometer was also 36°, Mr. Correll informs me. This farm is not perhaps quite so high above sea level as my place, but this corn is not growing in any depression. The whole farm is about at the same level, and surrounding farms are mostly at the same level. There was some frost damage in low places in other parts of this township (Plain) which I can understand, and I know that there are frost lines on higher or lower ground or different elevations, but such as this occurring on the farm of Mr. Correll I have never heard of before. Some information regarding this phenomenon, if anything on record in the history of the Weather Bureau, would be much appreciated; and if nothing on record as cause, etc., I believe it would be advisable for you to see the place and investigate the matter for the benefit of the service. If the damage does not show up in our crops more than now visible it was the queerest frost ever experienced in this section.

Yours, respectfully, CLAYTON HOLL.

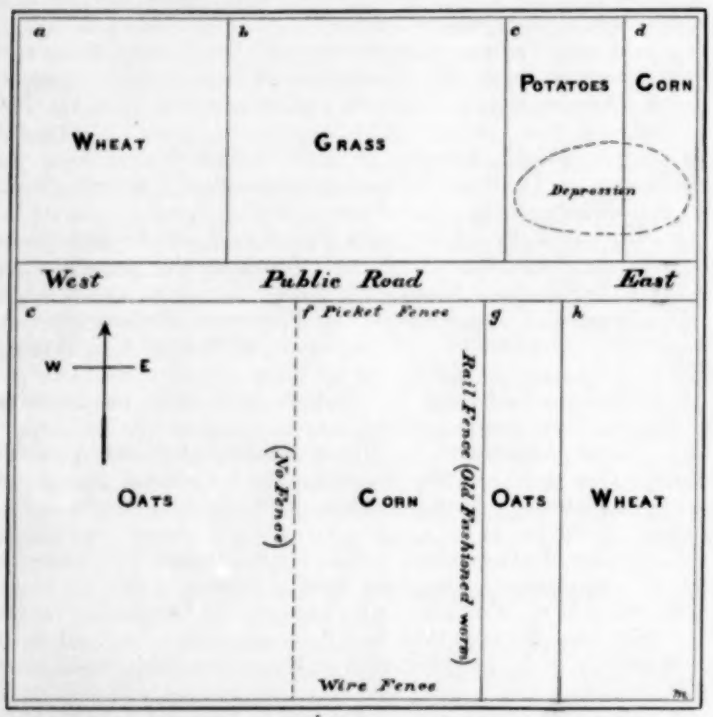


FIG. 1.—Diagram showing fields where peculiar frost damage occurred. *a*, 12 acres of wheat; *b*, 26 acres of grass; *c*, 35 rows (2½ acres) of potatoes; *d*, 16 rows of corn; in the depression indicated the corn and potatoes were badly damaged; *e*, 16 acres of oats, slightly higher than the corn when the frost occurred; *f*, 10 acres of corn; in this cornfield there was damage to about two rows around the outside, a little the worst along the rail fence on the east side; the corn was about 6 inches high when frosted; *g*, 4 acres of oats; *h*, 7 acres of wheat.

NEW BERLIN, OHIO, *June 27, 1908.*

Mr. J. WARREN SMITH,
Section Director, Columbus, Ohio.

DEAR SIR: I have to-day visited Mr. Correll's farm and have made a plat (fig. 1), rather roughly, but you will get some idea at least. This farm is mostly level and not particularly lower than surrounding farms. On the corn plot mostly damaged there is a slight hollow, possibly 8 or 10 feet lower in lowest place than other parts of corn plot, and there the corn will hardly recover to make a crop, while other parts will make possibly a full crop. There is also a farm nearly 1 mile south of Mr. Correll's place, where about 1½ acres of potatoes were nearly one foot high when frosted, and by appearance to-day will not make a crop; otherwise nothing seems to be damaged on this place. There were also in the village of Middle Branch, on several lots, a few sweet potato plants frozen, while those on adjoining lots were perhaps not touched. All this country surrounding is comparatively level and there is not much difference in the soil. The 16 rows of corn [on Mr. Correll's place] grew very fast and therefore may have been more tender than smaller corn, being on rich ground and some fertilizer being used, and planted the second week of May.

I believe this answers your questions, and perhaps when you hear from Washington we may get further information. For as low as the thermometer registered, it was the queerest frost ever experienced in this section in my lifetime of 50 years.

Yours, respectfully, CLAYTON HOLL.

Comment by J. Warren Smith, Section Director, dated Columbus, Ohio, July 18, 1908:

Mr. Holl says that the 16 rows of corn had grown very fast, being on rich soil and well fertilized, and therefore might have been more tender than smaller corn, but he cannot understand the reason for the injury to the two rows around the outside edge of the 10-acre lot.

An area of high barometric pressure lay over the northeast on the night of the 15th and there was a slight air movement across the State from the east or northeast. It is my opinion that the rail fence on the east and the picket fence on the north of this field served as sufficient wind-breaks to hold the air nearly still for a few feet close to the fences. This still air got colder than the surrounding moving air by the loss of its heat to the plants that were in turn cooled by radiation, thus the still air just past the freezing point and frost damage was caused. On the opposite side of the field the oats, being slightly higher than the corn, would also serve as a wind-break and hold a thin layer of air back for a few feet. The damage was not so great on this side as it was next to the rail fence.

In the other cases the damage was probably due to slight differences in elevation, color of the soil, character of the soil, or differences in the frost sustaining power of the plants.

EDITORIAL COMMENT.

The question is as to the injury done by the frost, whether it was due to (1) the tenderness of the plants or (2) the severity of the cold; and in the latter case whether it was due to (*a*) local cold air drainage or (*b*) more intense radiation. It is likely that each of these three causes was respectively responsible for the frost phenomenon in some particular part of the field.

As to the "two rows of corn around the outside edge of the 10-acre lot" nothing less than a careful personal study of this special field would possibly discover the true explanation. It is perfectly possible that on one side cold air drainage from the field to windward; on another side, rich, moist soil and plant tenderness; on the third side, excess of radiation unbalanced by reflection from the fence; on a fourth side, the local drainage of cold air from the field itself down to the "hollow" represented by Mr. Holl in his letter of June 27, 1908, resulted in damage by frost.—*C. A.*

NOTES FROM THE WEATHER BUREAU LIBRARY.

By C. FITZHUGH TALMAN, Librarian.

UPPER AIR OBSERVATIONS IN EGYPT.

At a meeting of the Royal Meteorological Society, London, May 20, 1908, Mr. B. F. E. Keeling, director of the Helwan Observatory (near Cairo) described the upper air observations that are being carried on in Egypt. The Nile flood, upon which the prosperity of all Egypt depends, is controlled by the rainfall of Abyssinia. As but few rainfall reports are obtainable from Abyssinia, where no meteorological service yet exists, it is hoped to make up for this lack of information by observing the upper air over Egypt by means of pilot balloons and kites. One interesting result already attained is the observation of the return trade wind, confirming the observations of Rotch and Teisserenc de Bort over the Atlantic Ocean. At Helwan the return trade is encountered at an altitude of about 6,500 feet. One balloon ascent, of 54,000 feet, appears to have past entirely thru the southwest return trade and to have encountered a northwest current above it.

METEOROLOGY IN PAPUA.

The annual report of the territory of Papua (British New Guinea) for the year ended June 30, 1907, contains the results of meteorological observations at three stations—Port Moresby, Samarai, and Daru—for the period July, 1906–June, 1907, inclusive. The northwest monsoon generally begins at these stations about the end of November and continues until March or April; the southeast trades prevail the rest of the year.

Instruments have been ordered for thirteen additional stations, so there is a prospect that Papua will shortly have a climatological service more nearly commensurate with its agricultural requirements.

METEOROLOGICAL WORK IN THE SOUTH ORKNEYS.

In the Scottish Geographical Magazine for July, 1908, Mr. R. C. Mossman describes the meteorological work carried on at Laurie Island, South Orkneys, (latitude 60° 44′ S, longitude 44° 39′ W.), by the Scotch observers who have entered the service of the Argentine Meteorological Office. The station was established by the *Scotia* Expedition in March, 1903, and since the departure of the *Scotia* in February, 1904, has been maintained by the Argentine Government, at an annual expense of $22,500. Mr. Mossman states that—

> Including the year's observations obtained by the Scottish National Antarctic Expedition, data covering five years are now available. The observations for 1904 are in the press and will be issued immediately, and the detailed values for the following three years will be in type about the end of this year, together with a complete discussion of the material for the whole period. The station on Wandel Island in 65° south, occupied by Doctor Charcot in 1904, will, it is hoped, be reestablished next summer by the Argentine Meteorological Office. The most pressing necessity now is for one or two years' observations at a continental station in from 70° to 74° south, between the meridians of 40° and 70° west. In this way the full value of the meteorological observations at the South Orkneys would be obtained, and the causes of the ebb and flow of the antarctic atmospheric circulation rendered apparent.

Observations are likewise carried on in South Georgia (latitude 54° 14′ S., longitude 36° 33′ W.), and the author presents an abstract of the results at both stations during the year 1907. Some interesting peculiarities of pressure distribution during August, 1907, are noted, which Mr. Mossman ascribes to an unusual extension northward of the "antarctic anticyclone" or permanent high-pressure area over the supposed Antarctic Continent.

THE LATE PRINCE YAMASHINA.

H. I. H. Prince Yamashina, of Japan, died May 2, 1908, in his thirty-second year. He was known to western science chiefly as the founder of an excellent meteorological observatory[1] on the summit of Mount Tsukuba, 65 kilometers northeast of Tokyo, together with a base station and a station at an intermediate altitude. The Prince received a part of his education in Germany, which explains why the results of the observations at his observatory have been published in German, under the title, "Ergebnisse der meteorologischen Beobachtungen auf dem Tsukubasan."

CHANGES AT THE HONGKONG OBSERVATORY.

The latest annual report of the Hongkong Observatory records the retirement in September, 1907, of Dr. W. Doberck, after twenty-four years' service as director. He is succeeded by F. G. Figg, late first assistant. Mr. Figg has been at Hongkong since 1883, having previously served as assistant and magnetic observer at Kew. A new first assistant has been appointed in the person of C. W. Jeffries, formerly at the Royal Observatory, Cape of Good Hope.

DEATH OF DOCTOR CRULS.

Nature (London) announces the death, in Paris, of Dr. Luiz Cruls, director since 1881 of the Observatory of Rio Janeiro. Doctor Cruls was the author of a memoir on the climate of Rio Janeiro. He was, however, probably best known to meteorologists in connection with his unsuccessful efforts, in the latter eighties, to interest meteorological institutions thruout the world in the compilation of a universal climatological dictionary.

[1] This observatory is described in Monthly Weather Review, October, 1904, XXXII, p. 463.

NEW OBSERVATORY AT CIENFUEGOS, CUBA.

The director of Belen College Observatory, Havana, writes that a new meteorological and seismological observatory is to be opened shortly at Cienfuegos, under the direction of his assistant, R. S. Sarasola, S. J.

MEETING OF BRITISH METEOROLOGISTS IN CANADA.

The meeting of meteorologists from all parts of the British Empire that was to have been held at Quebec in July of this year, in connection with the tercentenary celebration, has been postponed until 1909.

METEOROLOGY AT THE DRESDEN PHOTOGRAPHIC EXPOSITION.

At the International Photographic Exposition to be held in Dresden in October, 1909, special attention is to be given to scientific photographs, and one of the subsections is to be devoted to meteorology. Besides photographs of interesting meteorological phenomena, exhibits of photographic apparatus for meteorological measurements are desired; also publications relating to meteorological photography. Particulars regarding the meteorological part of the exposition may be obtained from Professor Süring, Nassauische Strasse 16 a, Wilmersdorf bei Berlin, Germany.

AERIAL OBSERVATIONS IN TROPICAL AFRICA.

The Scottish Geographical Magazine for August contains particulars regarding the African expeditions organized in connection with the "international week" of upper air observations arranged for July, 1908. Professor Palazzo, director of the Central Italian Bureau of Meteorology, was to embark at Zanzibar during July on the torpedo cruiser *Caprera*. One object of the expedition was the investigation of the monsoon winds on the coasts and in the interior of East Africa. Simultaneously British, French, and German expeditions were to carry on similar investigations in the subtropical zone of the interior. The German expedition was organized under the immediate patronage of the German Emperor, who contributed 50,000 marks ($12,500) for the purpose of meteorological research on Victoria Nyanza.

THE CLIMATE OF SPOKANE, WASH.

By CHAS. STEWART, Local Forecaster. Dated Spokane, Wash., January, 1908.
[Reprinted from 16th Annual Report, Board of Health of the city of Spokane.]

Spokane is situated in eastern Washington, latitude 47° 40° N., longitude 117° 25′ W., between the Rocky and Cascade mountains, at an elevation of about 1,900 feet above sea level.

The U. S. Weather Bureau office in Spokane was established February 1, 1881, giving up to date, January, 1908, meteorological records for over twenty-six years. In the preparation of the accompanying tables only whole years have been considered, leaving out the years 1881 and part of 1908, thus giving a record for twenty-six years, from 1882 to 1907, both years inclusive.

Owing to limited space, it is not practicable to remark fully upon these tables, and we shall, therefore, simply make a few statements, principally bearing on hygiene.

In comparing climates many people are inclined to be satisfied with a mere knowledge of the mean temperature, extremes of temperature, and perhaps the precipitation, of a place; forgetting that several places may have an equality of temperature in every respect, yet, owing to other important meteorological factors, differ widely as to climate.

The higher temperatures are shown to have risen above 90° each year, rising as high as 104° August 8, 1898; this might lead one unacquainted with the climate of Spokane to suppose

that prostration from heat, "sunstroke," occurs at this place, but such is not the case. On the contrary, here little inconvenience seems to accompany temperatures that in other places induce prostration from heat—"sunstroke" is entirely unknown here, save by name.

There are two climatic factors worthy of particular attention with regard to Spokane, viz: the mean daily change of temperature, and the "sensible temperature." The mean daily change of temperature is the change between the mean temperature of one day and that of another from day to day. This change is sometimes known as "variability of temperature," and is most important in determining the character of a climate; the more equable climates have the smallest changes of mean daily temperature. At Spokane the mean daily change of temperature for several years is 3.4°. This shows that the transition from cold of winter to heat of summer, or vice versa, occurs gradually by comparatively small changes of mean daily temperature from day to day. Sudden violent changes of temperature seldom occur here.

In order to understand what is meant by "sensible temperature" let us take the definition given in the MONTHLY WEATHER REVIEW[1] of the U. S. Weather Bureau.

> The *sensible temperature* experienced by the human body and attributed to the atmosphere depends not merely upon the temperature of the air, but equally upon the dryness and the wind. It would seem that the rapid evaporation from the skin in dry, hot weather reduces the temperature of the layer of nerve cells at the surface of the body. This reduction, or sensible coolness, may be measured by the difference between the dry and wet-bulb thermometers, in which case the resulting sensible temperatures are simply the temperatures of the wet-bulb thermometer as obtained by the whirling apparatus used in the shaded shelter, and correspond to the temperature felt by persons standing in the shade of trees or houses, exposed to a natural breeze of at least 6 miles per hour. The temperature of the wet-bulb thermometer and its depression below the dry bulb are the fundamental data for all investigations into the relation between human physiology and the atmosphere.

There is no difference in construction between the dry-bulb and wet-bulb thermometers, excepting that the thermometer selected as wet bulb has its bulb carefully covered with specially prepared muslin and is dipped in pure water before observation; hence the terms dry bulb and wet bulb, for the purpose of indicating which thermometer is meant. Immediately after dipping in water evaporation sets in from the bulb of the wet thermometer. This evaporation produces lowering of temperature, and the dryer the air the greater the difference between the readings of the wet bulb and the dry bulb, the reading of the latter indicating the temperature of the air.

To fully appreciate the hygienic value of a relatively low sensible temperature during the warm seasons, consider the afternoon observations taken at Spokane August 2, 1895. The temperature was 94° in the shade, and the temperature of the wet thermometer, or sensible temperature, was only 62°; that is, a person in good health and in the shade experienced a temperature of only 62°, although the air temperature at the time was 94°—a difference of 32° between the air temperature and the sensible temperature. This is worthy of notice, as it is somewhat explanatory of the freedom from prostration from heat, "sunstroke," for which this section is noted. The sensible temperature is influenced by the relative humidity, and the low relative humidity during the warm portions of the year is one of the most important factors in freedom from sunstroke at Spokane.

Table 1 gives the average relative humidity for this place as 65.8 per cent; but during the warmer months of the year, the relative humidity often falls in the afternoon, about the warmest part of the day, to as low as 10 per cent, sometimes lower. For example, at the afternoon observation (taken in Spokane at 5 p. m., Pacific time), August 16, 17, and 18, 1895, the relative humidity was, respectively, 8, 7, and 5 per cent; but at the morning observation (5 a. m., Pacific time), August 17, 18, and 19 the relative humidity had risen to 51, 52, and 53 per cent, showing that the air does not remain long enough "dry" to be hurtful in some respects.

Each year, excepting the years 1895, 1897, 1901, 1903, 1904, and 1906, the temperature has fallen below zero at Spokane; but it is also shown that during the winters of 1888–89, 1894–95, 1895–96, 1897–98, 1899–1900, 1902–3, and 1903–4 the temperature did not fall as low as zero at this place. The lowest temperature recorded at Spokane since the opening of the Weather Bureau office here was —30.5°, January 16, 1888, but it should be borne in mind in this connection, that the winter of 1887–88 was one of great severity thruout the whole country. The lower temperatures do not prevail for many days at a time, but have days with much higher temperature between them.

The prevailing winds are from the southwest and have a marked influence in tempering the cold of winter or heat of summer. The greatest velocity of wind ever recorded at Spokane was 52 miles per hour, July 15, 1902, but this velocity lasted only a few minutes. This place is remarkably free from violent winds, due in a great extent to the topography of the surrounding country. The violent and destructive tornado is not experienced here.

Thunderstorms are rare and seldom, if ever, of the violent kind experienced in the Eastern States—many of the thunderstorms recorded in Table 1 have been reported for only a peal or two of distant thunder.

It has been estimated by agricultural experts that from 15 to 20 inches of precipitation per year suffice for the production of good crops in the agricultural sections near Spokane. Weather Bureau reports referring to Washington and Oregon indicate that agricultural operations are more fruitful with a small rainfall than in some sections of other States with considerably larger precipitation. An examination of Table 1, which shows the amount of precipitation for the greater part of the agricultural year, indicates that a sufficiency of precipitation for agricultural needs has always fallen in this section; and the same table shows that, in general, the rainfall has been well distributed during the period critical for agriculture.

In Table 1 it is shown that on an average Spokane has 100 clear days, 112 partly cloudy days, and 153 cloudy days in the year. On many of the cloudy days, however, as well as the partly cloudy days the sky is not fully overcast, or is overcast by a thin stratum of cloud that permits some technically "cloudy" days to be days of sunshine.

The "actual atmospheric pressure" given in the forepart of the tabular statement should be of interest to physicians and others from a physiological point of view.

Not once, since the opening of the U. S. Weather Bureau office (over twenty-six years ago) in this place, has there been an instance of loss of life or property at Spokane caused by extreme meteorological conditions, such as occur yearly in other parts of the country.

The topography of the country surrounding Spokane is well adapted to give to this place its peculiar climate. Situated in eastern Washington at an elevation of about 1,900 feet above sea level, and about midway between the Cascades and Rocky mountains, Spokane is near enough to the vast Pacific Ocean to be under its climatic influence to a great extent, while the Cascade Range intercepts precipitation from the northern Pacific coast that might otherwise be excessive, and the mighty range of the Rocky Mountains to the eastward and spurs to northward of Spokane deflect far to eastward of this place the intense "cold wave" that yearly comes from the extreme north and pours down along the eastern slope of the Rocky Mountains into middle, eastern, and southern portions of the United States.

[1] Monthly Weather Review. 1895, XXIII, p. 84–5.

The following table of average temperatures for Spokane was obtained by taking the average of the mean temperatures for each month in the year for the period extending from the opening of the Weather Bureau office in Spokane up to December, 1903, a period of nearly twenty-three years.

Average temperature at Spokane for each month of the year.

	°F.		°F.
January	26	July	69
February	30	August	68
March	40	September	58
April	48	October	48
May	56	November	37
June	62	December	32

Snowfall by winters, inches and tenths.

1885–86	17.6	1893–94	50.1	1900–1901	31.9
1886–87	36.7	1894–95	37.7	1901–2	14.5
1887–88	42.8	1895–96	47.5	1902–3	28.6
1888–89	22.1	1896–97	65.3	1903–4	45.8
1889–1890	79.1	1897–98	52.6	1904–5	11.1
1890–91	30.1	1898–99	56.4	1905–6	27.8
1891–92	38.5	1899–1900	19.2	1906–7	44.2
1892–93	69.3				

The above table gives the total amount of snow that fell during each winter from that of 1885–86 to date; it does not give the greatest depth of snow on the ground at any one time, but at Spokane traffic is seldom, if ever, seriously interfered with by a large amount of snow on the ground.

TABLE 1.—*Meteorological data for Spokane, Wash., for twenty-six years, 1882–1907.*

Years.	* Barometer.			Temperature.				Rainfall and melted snow.			Distribution of rain during period critical for agriculture.			Wind.	
	Mean annual.	Highest.	Lowest.	Mean annual.	Highest.	Lowest.	Annual range.	Total amount.	Agricultural year, greater part of September to June, ten months.		May.	June.	July.	Prevailing direction.	Highest hourly velocity.
	Inches.	*Inches.*	*Inches.*	*°F.*	*°F.*	*°F.*	*°F.*	*Inches.*	*Years.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*		*Miles.*
1882				46.5	101.5	−17.0	118.5	**25.09**	1881–82	**23.01**	1.54	1.17	0.88	sw.	44
1883	**28.01**	28.68	27.33	46.8	96.7	−27.7	124.4	14.37	1882–83	22.06	2.11	0.60	0.00	sw.	37
1884	27.96	**28.62**	27.11	*45.5*	97.5	−17.8	115.3	20.56	1883–84	14.59	0.56	2.58	1.06	sw.	29
1885	27.98	28.50	27.45	**50.1**	99.3	−14.0	113.3	19.01	1884–85	18.84	1.53	3.40	0.39	sw.	33
1886	27.96	28.59	27.26	48.7	100.3	−10.5	110.8	15.86	1885–86	15.21	0.92	0.56	0.37	sw.	42
1887	27.98	**28.61**	27.15	47.2	97.3	−11.0	108.3	20.10	1886–87	18.69	1.06	2.07	1.41	sw.	31
1888	28.00	**28.75**	**27.47**	48.7	101.8	*−30.5*	**132.3**	17.69	1887–88	18.40	1.24	5.12	0.06	sw.	30
1889	28.00	28.57	27.41	49.1	96.0	−10.0	106.0	14.27	1888–89	*12.35*	1.70	0.39	0.46	sw.	30
1890	27.97	28.63	27.25	47.4	102.0	−23.0	125.0	16.57	1889–90	19.45	1.59	1.98	0.38	sw.	48
1891	27.95	28.58	*26.98*	49.0	97.0	−10.0	107.0	16.69	1890–91	*12.35*	0.60	3.28	1.12	sw.	48
1892	27.98	28.45	27.34	48.4	96.0	− 5.0	101.0	16.78	1891–92	14.45	2.40	0.72	1.22	s.	36
1893	27.97	28.60	27.28	45.7	99.1	−19.0	118.1	22.00	1892–93	20.08	2.50	0.42	0.36	s.	36
1894	27.97	28.61	27.32	48.2	97.5	− 1.9	99.4	17.84	1893–94	20.09	1.01	1.13	0.29	sw.	39
1895	28.00	28.52	27.27	48.0	95.0	8.0	*87.0*	13.46	1894–95	12.66	1.58	0.42	0.42	sw.	42
1896	27.96	28.56	27.38	48.6	100.0	−13.0	113.0	20.82	1895–96	14.78	2.29	0.73	0.17	sw.	37
1897	27.96	28.56	27.24	48.2	100.0	3.0	97.0	23.84	1896–97	21.43	1.05	**3.51**	0.98	sw.	37
1898	27.97	28.62	27.46	48.2	**104.0**	− 2.0	106.0	*13.08*	1897–98	18.64	1.63	1.21	0.43	s.	41
1899	*27.94*	28.50	27.23	47.2	98.0	−21.0	119.0	20.08	1898–99	13.27	1.02	0.56	0.30	s.	36
1900	27.96	28.66	27.25	49.8	100.0	−10.0	110.0	18.72	1899–1900	17.38	2.12	0.42	0.34	sw.	48
1901	27.97	28.58	27.42	48.9	99.0	**10.0**	89.0	15.99	1900–1	18.81	1.26	1.05	0.61	s.	38
1902	27.95	28.51	27.14	47.9	*94.0*	−12.0	106.0	19.23	1901–2	15.79	1.83	0.45	1.71	sw.	**52**
1903	27.99	28.54	27.12	47.5	97.0	4.0	93.0	16.55	1902–3	13.96	1.34	1.35	1.13	s.	40
1904	27.96	28.48	27.10	49.9	100.0	6.9	93.1	13.97	1903–4	16.65	0.13	1.24	0.34	s.	40
1905	27.98	28.53	27.37	48.2	103.0	− 7.0	110.0	16.68	1904–5	12.59	1.98	4.16	0.06	ne.	40
1906	27.97	28.54	27.17	49.4	99.1	6.9	92.2	17.60	1905–6	14.86	3.42	1.02	0.02	sw.	36
1907	27.96	*28.43*	27.25	47.1	96.9	− 3.1	100.0	17.69	1906–7	17.40	2.60	**0.96**	1.00	s.	40
Average	27.97			48.1			107.4	17.90		16.82	1.58	1.56	0.60	sw.	

Years.	Number of days.						Mean relative humidity. †	Thunderstorms.	Number of days, and month in which temperature fell to zero.	Winters during which the temperature did not fall below zero.	Mean daily change in temperature.	Average velocity of wind.	Frost.			
	Clear.	Partly cloudy.	Cloudy.	.01 inch or more rain or snowfall.	Temperature above 90°.	Temperature below 32°.							First.		Last.	
													Light.	Killing.	Killing.	Light.
							Per cent.					*m. p. h.*				
1882	92	132	141	141	17	121	68.6	17	8, Jan			5.6	Sept. 30	Nov. 2	Mar. 20	May 20
1883	181	126	58	94	14	136	67.1	2	6, Jan., 11, Feb			4.2	Oct. 3	Nov. 2	Mar. 16	April 5
1884	113	151	97	123	10	128	69.4	10	7, Feb., 9, Dec			3.5	Sept. 12	Sept. 7	April 18	May 13
1885	141	137	87	116	15	84	75.5	10	4, Jan			4.6	Oct. 5	Nov. 3	Mar. 19	April 25
1886	176	114	75	104	14	113	70.6	6	6, Jan			4.6	Sept. 28	Oct. 10	Mar. 2	April 5
1887	105	153	107	126	15	137	78.2	8	9, Feb	1888–89		3.9	Sept. 22	Sept. 20	Mar. 4	May 7
1888	98	111	157	106	28	115	68.4	4	9, Jan			4.3	Sept. 23	Oct. 18	April 17	May 21
1889	74	132	149	97	19	115	64.0	5	1, Dec		3.7	4.1	Sept. 24	None.	Feb. 19	April 17
1890	98	120	147	117	14	122	62.0	3	5, Jan., 4, Feb		3.7	4.1	Sept. 12	None.	Jan. 11	May 30
1891	82	122	161	123	17	108	61.0	5	3, Mar		3.7	5.3	Oct. 1	Nov. 13	June 8	May 9
1892	104	124	138	119	10	103	62.0	2	2, Jan		3.4	5.5	Sept. 16	Sept. 21	Feb. 18	May 4
1893	78	105	182	144	12	123	68.0	4	1, Jan., 3, Feb		3.8	5.8	Aug. 10	Oct. 14	Jan. 15	June 20
1894	62	118	185	137	19	107	64.2	6	1, Jan., 2, Feb	1894–95	3.9	6.5	Sept. 23	None.	April 3	June 11
1895	81	126	158	98	8	121	60.0	5	None	1895–96	3.6	6.1	Sept. 6	None.	None.	June 14
1896	97	99	170	*118	22	92	63.3	3	3, Nov		3.4	6.0	Sept. 16	Oct. 27	April 20	May 27
1897	118	69	178	134	17	119	66.0	8	None	1897–98	4.0	5.6	Sept. 9	Oct. 3	April 12	April 27
1898	131	97	137	101	21	119	62.0	7	1, Dec		3.5	6.2	Oct. 1	Oct. 5	May 7	May 24
1899	90	112	163	134	8	95	65.0	5	5, Jan., 4, Feb		3.9	6.4	Sept. 7	Oct. 14	Mar. 17	May 15
1900	66	86	213	124	12	79	66.0	17	1, Nov		3.6	6.0		Sept. 26	April 9	June 9
1901	90	109	166	113	14	103	65.0	7	None		3.2	5.6	Sept. 15	Nov. 2		June 11
1902	71	87	207	127	8	92	66.0	5	5, Jan., 1, Feb	1902–3	3.5	5.9	Sept. 17	Nov. 5	Mar. 3	June 6
1903	79	86	200	104	9	124	65.0	11	None	1903–4	3.6	6.1	Sept. 13	Nov. 10		May 23
1904	85	87	194	112	27	102	63.0	7	None		3.5	6.5	Sept. 11	Oct. 28	April 17	June 24
1905	102	78	185	118	17	128	65.0	16	2, Feb	1905–6	3.6	5.8	Sept. 1	Oct. 9	May 1	May 25
1906	91	91	183	113	25	109	64.0	9	None		3.5	6.0	Sept. 11	Oct. 21	None.	May 5
1907	74	140	151	106	4	107	67.2	14	2, Jan		3.4	5.9	Sept. 21	Nov. 6	None.	June 15
Average	100	112	153	117	15	112	65.8	8					Sept. 17	Oct. 17	Mar. 23	May 19

* Barometer corrected for instrumental error and temperature (actual atmospheric pressure). † Mean of 7ª + 3ᵖ + 11ᵖ prior to July 1, 1888; mean of 8ª + 8ᵖ after that date.
In Table 1 full faced figures indicate the highest and italic figures the lowest values of each element.

THE CLIMATE OF THE CANADIAN YUKON.

The following extracts from an article by F. A. McDiarmid[1] in the Journal of the Royal Astronomical Society of Canada, will assist us in forming a correct idea of the climatic conditions of the upper Yukon Valley, at least during the summer months:

The enchanting beauty of the wide-spreading Yukon Valley—its glorious sunshine and its wealth of vegetation and fruit and flowers—comes as a great surprise to one who beholds it for the first time, and often causes the exclamation "This can not be the North." Indeed it is not the north land of which we have read and thought perhaps to see, but away off in the distant blue are still the mountain peaks, capped with eternal snow. No more glorious summers are to be found anywhere on the earth's surface, nor for the sportsman can the northern autumn be excelled. Here in the late fall you can hear the moose and the cariboo calling that it is time to get into their favorite meadows where they winter, and in the white, soft evenings the goats and sheep are heard tramping in droves and seeming to confer as to the best location for their exodus; the grouse call softly in the thickets; the squirrels are busy adding to their already overflowing storehouses; and there are also the bears—black, grizzly, brown, and cinnamon—fat and sleek; and in the sedges can be heard the ducks and geese discussing their annual excursion to the south—truly a hunter's paradise.

People are always interested in the climate and continually ask "What is your weather?" We have no idea of the beautiful summers of the Yukon; we imagine that Dawson is a cold, barren place, and that even in the middle of summer snow is seen on every hand. Such notions are indeed far from the actual facts. The months of May, June, July, August, and part of September are regular paradises and are the finest we meet in any part of Canada. The visitor who expects to need heavy clothing is agreeably surprised; the sun shines for a large part of the twenty-four hours; indeed, at latitude 64° 40′ there is continuous daylight during the months of June and July. To the pole more heat comes from the sun during the 21st of June than comes to any other point on the earth's surface during any day of the year. Then, the sun giving out his heat and light makes it a desirable resort for the summer months. It is true that ice is found only a short distance below the surface of the ground, yet the traveller is perfectly ignorant of such a circumstance unless it be pointed out to him. The thermometer often registers 85° F. during the day and the evenings are clear and cool for sleeping. Vegetation is very rapid; the abundance of sunlight hurries things along; the heat from above combined with the moisture from below causes rapid growth; and consequently Dawson can boast of the finest vegetables in the world. Her lettuce, celery, beets, carrots, cabbages, and cauliflowers are unexcelled. As we go along the streets most brilliant flower gardens meet us on every hand, and if we forget ourselves a moment we would think we were in some tropical land. But the refreshing breeze from the mountain far away recalls us to ourselves.

We have described the Yukon from the standpoint of landscape and scenery. Let us now see it from the position of an astronomer. The weather of the Yukon is ideal for astronomical work, there being but little rain during the summer months. The experience of the writer during the season of 1906 was one cloudy night from the 13th August till the 7th September, while during the season of 1907 observations were obtained on 21 consecutive nights. On 19 of these the conditions were ideal for observing. The months of June or July give us only about three or four hours each night suited for observing, but if the observer has only a few hours at his disposal daily, yet he feels confident that nearly every night will be perfect. There is very little humidity in the atmosphere at any time; and consequently the stars are very steady and clearly defined. One can observe with comparative ease a sixth magnitude star in June when there is broad daylight. Often when we are waiting for good weather here in the East, and see night after night go by and nothing but clouds rewarding us, then we wish that we might have a few of the clear nights of the North.

* * * * * * *

Another phenomenon that greatly affects the telegraph line is the Northern Lights; when the display of aurora is by any means brilliant it is almost impossible to keep the telegraph instruments adjusted. But if difficulties were presented in the way of our signal exchange, yet the beautiful display in the heavens quite repaid for any extra trouble. The scene can not be described; the whole sky was one magnificent picture with the scene continually changing; as the lights chased one another across the sky a peculiar buzzing sound was heard. To one who has never been in the North the phenomenon of the aurora borealis is very impressive indeed.

[1] Determination of the one hundred and forty-first meridian. Journal Roy. Astron. Soc. of Canada, 1908, Vol. II, p. 84–95.

THE STUDY OF ENGLISH.

The following quotation from the Michigan Alumnus for May, 1908, applies as well to meteorologists as to engineers:

There can be no doubt of the final value of English to the professional man, although it is only recently that it has been recognized. Time was—and that not long ago—when English, as a definite study, was overlooked entirely, or at best wofully underestimated, to the advantage of other studies of less practical importance. It is precisely this point, the practical value of English to the professional man, as represented by the engineer, that forms the basis of an article by H. P. Breitenbach, of the engineering faculty of the university, which appears in the March number of the Engineering Digest. One engineer quoted in the article regards it "more important even that the engineering student should be proficient in the writing of English than the collegian. The ability to express himself clearly and accurately may be said to be a tool of his trade, for he has to write reports and prepare specifications, the very soul of which is accuracy." As expressed in a quotation from another engineer, "The big work of the engineer is done with the typewriter rather than with the slide-rule or T square." The cultural value of English, as distinguished from the technical or professional, is important, for it opens up avenues of approach into the literature of science, history, and art, not only increasing the general usefulness of the engineer and his individual enjoyment, but proving of practical importance to him as a business man in his social and business relations.

The testimonial value of the preceding phrases is emphasized by the fact that they are mainly quotations from letters received by the engineering department of the university, as an outcome of a discussion that arose in an English class of junior engineers. The members of this class wrote to alumni of the department on various questions at issue, and among these was the value of English to the practicing engineer. All of the fifty replies received agreed in ascribing to English a high value among the assets of an engineer, with its chief professional applications—in addition to the furthering of his command of speech—the writing of business letters, articles for the press, reports, contracts, and specifications.

Among the comparatively new applications of English in the special field of engineering is the writing of technical catalogues, pamphlets and other advertising matter, and the editing of technical journals. The latter field may be called a product of the last quarter century, and is only just now offering desirable openings for engineers.

THE SMITHSONIAN METEOROLOGICAL TABLES.

Mr. Charles S. Wood, Research Observer at Mount Weather, Va., under date of July 14, 1908, writes as follows:

I have the honor to call attention to the following inaccuracies that occur in the Smithsonian Meteorological Tables, second and third revised editions:

Page.	Value for—	Printed—	Should be—
185	27.65	702.21	702.31
110	467	3791	3891
110	468	3774	3874
110	469	3757	3857

These occur in the tables that we use in computing our kite records, and I take this opportunity to call attention to them in order that they may be corrected in future editions.

NATIONAL CONSERVATION COMMISSION.

Eminent statesmen, engineers, foresters, and geologists to the number of 50 constitute this commission, which is organized in four sections relative to waters, forests, lands, and minerals, respectively. The spirit that is to animate the commission is well exprest in the following extract from President Roosevelt's letter of instructions:

The work of the Commission should be conditioned upon keeping ever in mind the great fact that the life of the nation depends absolutely on the material resources, which have already made the nation great. Our object is to conserve the foundations of our prosperity. We intend to use these resources; but to so use them as to conserve them. No effort should be made to limit the wise and proper development and application of these resources; every effort should be made to prevent destruction, to reduce waste, and to distribute the enjoyment of our national wealth in such a way as to promote the greatest good of the greatest number for the longest time.

The Commission must keep in mind the further fact that all the natural resources are so related that their use may be, and should be, coordinated. Thus, the development of water transportation, which requires less iron and less coal than rail transportation, will reduce the draft on mineral resources; the judicious development of forests will not only supply fuel and structural material, but increase the navigability of streams, and so promote water transportation; and the control of streams will reduce soil erosion and permit American farms to increase in fertility and productiveness, and so continue to feed the country and maintain a healthy and beneficial foreign commerce. The proper coordination of the use of our resources is a prime requisite for continued national prosperity.

* * * * * * *

There is no break between the interests of State and nation, these interests are essentially one. Hearty cooperation between the State and national agencies is essential to the permanent welfare of the people.

Of course there are many other national resources, material, physical, intellectual, and psychical, that have contributed to make this nation great and which must also be developed and conserved.

We can not proceed wisely and successfully to the conservation of the water supply without solving preliminary problems, some of which are meteorological, such as the evaporation of snow and water under the influence of sunshine and wind. In the conservation of forests and in reforestation we need more minute knowledge than we now have of the influence of snowfall, rainfall, sunshine, and temperature.

The atmosphere in its purity is a prime factor in the matter of health and disease; the conservation of the national health and bodily vigor is a matter of first importance. But the conservation of the intellectual vigor and high moral tone of the people is, far and away above all other considerations, that which will contribute to maintain it in its high position during future ages.

Montesquieu long ago defended the thesis that climatic influences are directly or indirectly responsible for the laws of nations. Dexter and Ward have shown that the struggle of man against adverse features of climate has had great influence on his education, ethics, and morals. The first principles of evolution show to what great extent the weather and the climate have affected the physical development and material progress of nations. Ibsen presents to us "Brand" in the act of choosing between the superstition, deception, supineness, and baseness of the lowlanders and the aspiration, nobility, and energy of the mountaineers; as tho the clear sunshine, cool air, and dry winds of the upper atmosphere lifted man to a higher plane of living.

Are we not all conscious of the truth of the fact that if possible we would annually flee to the upper air of the mountains or the purer air of the ocean in order to obtain physical and mental strength for the life that most of us must lead in the lowlands?

When we feel the inspiration of the fresh life that we breathe in with our pure, cold, clear, dry northerly winds, are we not taking in great drafts of our most precious national resource, i. e., the descending mass of air that pours down upon us from the upper regions of the atmosphere. It flows from Canada to the Gulf of Mexico, from the Rocky Mountains to the Atlantic coast. It lifts up the lower moist air and gives us rain. It freezes the swamps and kills fevers and malarias. Some say there is ozone in it, but that is only another word for health and vigor. As it is sure to bring cool weather in summer, but very cold in winter, we have learned to count upon its beneficent influence in numerous ways with certainty.

No other region of the world has yet been discovered where this pure upper air comes down to man so freely and opportunely. It descends almost as soon as we begin to feel the need of it and ceases when we have had just enough. Summer or winter it is equally welcome and useful. It blesses the land east of the Rockies, and, if we could, we would so conserve it that those living west of the mountains could enjoy it blessings. But the Pacific coast has its own special climate, and nothing that man can do will alter that, while the whole nation is richer for having at its disposal two extensive climatic regions, separated by an equally extensive plateau region. The conservation of national vigor will eventually require a continual interchange between the inhabitants of these three regions. It is oftentimes as important for the highlanders to return to the lowlands as it is for the rest of us to flee to the mountains. Experience has shown that Europeans who have spent several years in the Tropics must occasionally return to the northern climate for a breath of fresh air. India has its mountain resorts in the Himalayas; the government officials at Calcutta must spend half the year at Simla.

The summer climate of Washington is as bad as that of Calcutta. Will not the conservation of the energies of our Government officials eventually necessitate an annual hegira to the dome of our continent in Colorado?

WHERE AND HOW CAN OUR OBSERVERS PURSUE THE STUDY OF MODERN SCIENCE?

When it lately came to the knowledge of the Editor that an assistant observer had found a way to prosecute a course in laboratory physics and attain an advanced collegiate standing it occurred to him that many others would, by such an example, be encouraged to undertake similar studies. He has, therefore, secured permission to publish the following sketch of activity during the years 1903–08. The reader must, therefore accept this sketch not as being from Mr. Hooper, but from the Editor himself as showing that, to those who have the will, the way will be opened.

There are very many Weather Bureau stations located near good schools of science and polytechnics. The Weather Bureau Form No. 4047—Mis., seems to allow every observer an opportunity to state his desire to remain at his present station until he can finish the local collegiate course in modern languages, mathematics, physics, etc. It will not, in general, be possible to give him a new assignment to a station that has special advantages for study; but one can at least make the most of the advantages that he has, and hope for better in the future.

The object of such advance in scientific education is not, necessarily, to evolve a corps of researchers, tho doubtless a few geniuses may thus be discovered, but to so increase our general intellectuality that we may truly respond to the widespread popular belief that the Weather Bureau observers, section directors, and forecasters represent a very high type of government official.

This appeal is to the young men in the service—some of us are too old to be accepted as college students.—*C. A.*

WEATHER BUREAU MEN AS UNIVERSITY STUDENTS.

By JOHN K. HOOPER, Observer. Dated New Haven, Conn., July 18, 1908.

The Editor suggests that I write an article for publication in the MONTHLY WEATHER REVIEW, showing how it has been possible for me to take a special course of study at Yale University while performing the regular duties of assistant in the local office of the Weather Bureau at New Haven, Conn.

During the several years devoted to reading and study incident to preparing for the examinations required in the Weather Bureau as tests of educational efficiency, I became anxious to obtain a more extended knowledge of the branches of science germane to meteorology, than a mere course of reading could accomplish. I then decided that whenever an opportunity offered I would take up a course in those branches, under competent instruction.

The opportunity came to me when I was assigned to New Haven station in 1903. I made an added effort to complete the Weather Bureau examinations as soon as possible, and was able to register in the graduate department of Yale University at the opening of the college year in 1906.

By the advice of the university authorities, to whom I had explained just what I hoped to accomplish, and, with the permission of the Chief of Bureau, I took up the following preparatory course of study:

Elementary physics, three hours per week, Monday, Wednesday, and Friday, 2 p. m. Elementary laboratory physics, three hours per week, Thursday, 2 p. m. Analytical geometry and calculus, three hours per week, Tuesday, Thursday, and Saturday, 11:30 a. m.

These were the undergraduate courses of the academic department. They continued thruout the year.

The following year I took: Introduction to theoretical physics, three hours per week, Monday, Wednesday, and Friday, 11:30 a. m. This course continued thruout the college year of 1907–8.

During the first year I arranged to be excused from station duty on Monday, Wednesday, and Friday, from 2 to 3 p. m. then returned to the office and worked that much longer on those days. On Thursday I was excused from 2 to 5 p m. and after the period in the labratory, I remained at the office until the evening observation, and the work connected with it had been finished, eating the evening meal after that time.

It was not necessary to make any especial arrangement for mathematics on Tuesday, Thursday, and Saturday, as that period was during my lunch hour. To save time, however, I brought my lunch with me on those days and ate it in the office after 12:30 p. m. I did this same way during the second year on Monday, Wednesday, and Friday.

The studying was done at home in the evening. I did not attempt a regular schedule for each day, but took as much time as the various assignments required, sometimes being up until quite late. I allowed myself at least one evening each week for recreation, and took a complete rest on Sunday with the exception of station duty in the evening.

I do not say that this course has been taken without some self-denial and discomfort, but I am certain that with this additional knowledge of physics and mathematics I am now better equipped to pursue the study of meteorology, and this more than counterbalances any inconvenience I may have undergone while obtaining it.

I do not consider that I have accomplished more than is possible for the majority of Weather Bureau employees. Many are even more conveniently situated than I have been, particularly those whose stations are located in university buildings or on university ground. The hours of duty in the service are such that any man so inclined can pursue some branch of study helpful to himself, and thru him of benefit to the Bureau.

Other branches of science are looking to meteorology for the solution of many of their own problems. Geographically we are the best fitted of any nation to solve the problems of the atmosphere. This should be a sufficient incentive to the men of the United States Weather Bureau to do all in their power to place meteorology in its proper position in coordinated knowledge—among the exact sciences.

RECENT ADDITIONS TO THE WEATHER BUREAU LIBRARY.

C. FITZHUGH TALMAN, Librarian.

The following titles have been selected from among the books recently received, as representing those most likely to be useful to Weather Bureau officials in their meteorological work and studies. Most of them can be loaned for a limited time to officials and employees who make application for them. Anonymous publications are indicated by a ——.

Association française pour l'avancement des sciences.
Compte rendu de la 36me session. Reims 1907. Notes et mémoires. Paris. 1908. 1718 p. 8°.

Baden. Centralbureau für Meteorologie und Hydrographie.
Anleitung für die meteorologischen Stationen in Grossherzogtum Baden. Karlsruhe. 1908. 48 p. 8°.

Bemmelen, W. van.
On the rainfall in Java. Results of the observations at more than 700 stations in the period 1879 to 1905. Batavia. 1908. 83 p. f°.

British Guiana. Botanic gardens.
Report ... 1896–1907. Georgetown. 1898–1907. f°.

Claudel, J.
Handbook of mathematics. New York. 1906. ix, 708 p. 8°.

Colorado college observatory.
... Semiannual bulletin no. 5. Meteorological statistics for 1907. Colorado Springs. 1908. p. 101–135. 8°. (Colorado college publications. General series no. 36. Science series v. 12. no. 5.)

Durand-Gréville, E.
... Le mammatus. Paris. 8p. (Extrait du Bulletin de la Société astronomique de France, Janvier 1901.)

Egypt. Survey department.
Instructions for the meteorological observers [English and Arabic]. n. t. p. 7 p. f°.

Foerster, Wilhelm.
Von der Erdatmosphäre zum Himmelsräume. Berlin. 1906. 115 p. 8°.

France. Bureau central météorologique de France.
Annales. Année 1905. II. Observations. Paris. 1908. v. p. f°.
Same. III. Pluies. Paris. 1907. (8), 145 p. f°.

Hedrick, U. P.
The relation of weather to the setting of fruit; with blooming data for 866 varieties of fruit. (New York Agricultural station. Bull. no. 299. March, 1908. Geneva. 138 p. 8°.)

Hejas, E. and Rethy A.
Die Häufigkeit des Niederschlags in Ungarn nach 15-jährigen Beobachtungen (1886–1900) von 20 Stationen. Budapest. 1908. 23 p. f°. (Aus den Jahrbücher der königl. ung. Reichsanstalt für Meteorologie und Erdmagnetismus. 35. Band. Jahrgang 1905. 4. Theil.)

Hörmann, Ludwig von.
Wetterherren und Wetterfrauen in den Alpen. (Sonderabdruck aus der Zeitschrift des Deutschen und Österreichischen Alpenvereins 1907 (38. Band).) München. 1907. p. 93–114. 4°.

Innsbruck. Universität. Meteorologisches Observatorium.
Beobachtungen ... 1905. Innsbruck. 1907. n. p. 8°.

Italy. Ufficio centrale di meteorologia e di geodinamica.
Annali ... Serie seconda. v. 17. Partie 3. 1895. Roma. 1907. xii, 283 p. f°.

Manchester university. Meteorological department.
Report on the investigation of the upper atmosphere carried out at the Howard estate observatory, Glossop ... 1906–1907. Manchester. 1908. n. p. 4°.

Mellor, J. W.
Higher mathematics for students of chemistry and physics . . . 2d ed. New York. 1905. xxi, 631 p. 8°.

Natal. Government astronomer.
Report . . . 1907. Durban. 1908. 14 p. f°.

Prussia. Meteorologisches Institut.
Ergebnisse der Beobachtungen an den Stationen II. und III. Ordnung . . . 1906. Heft 2. Berlin. 1908. 39–74 p. f°.
Ergebnisse der Gewitter-Beobachtungen . . . 1903, 1904, und 1905. Berlin. 1908. xxxi, 102 p. f°.
Ergebnisse der meteorologischen Beobachtungen in Potsdam . . . 1904. Berlin. 1908. xlii, 128 p. f°.
Ergebnisse der magnetischen Beobachtungen in Potsdam . . . 1905. Berlin. 1908. 82 p. f°.
Ergebnisse der Niederschlags-Beobachtungen . . . 1905. Berlin. 1908. xxx, 164 p. f°.

Scott, William B.
An introduction to geology. 2d ed. rev. New York. 1907. xxv, 816 p. 8°.

Selby, A. D.
Fall and early winter injuries to orchard trees and shrubbery by freezing. (Bulletin of the Ohio agricultural experiment station. no. 192. Feb., 1908. p. 129–148.)

Sjutz, Hermann.
Ueber die Bedeutung der Verwitterung für die Umgestaltung der Erdoberfläche. Inaug.-Diss . . . Bonn. Lübbecke. 1907.

Tananarive. Observatoire de Madagascar.
Observations météorologiques . . . 17 v. 1906. Tananarive. 1908. vi, 273 p. 8°.

Upsala. Université. Observatoire météorologique.
Bulletin mensuel. v. 39. Année 1907. Upsala. 1907. 74 p. f°.

Western Australia. Government astronomer.
Meteorological observations made at the Perth observatory, and other places in Western Australia. . 1906. Perth. 1907. 143 p. f°.

Wetzel, Guilherme.
Contribuiçao para o estudo de climatologie de Rio Grande do Sul. Observaçoes meteorologicas feitas durante o periodo de 1893 a 1907. n. p. n. d. n. pag. 8°.

RECENT PAPERS BEARING ON METEOROLOGY AND SEISMOLOGY.

C. FITZHUGH TALMAN, Librarian.

The subjoined titles have been selected from the contents of the periodicals and serials recently received in the Library of the Weather Bureau. The titles selected are of papers or other communications bearing on meteorology or cognate branches of science. This is not a complete index of the meteorological contents of all the journals from which it has been compiled; it shows only the articles that appear to the compiler likely to be of particular interest in connection with the work of the Weather Bureau. Unsigned articles are indicated by a ——

Engineering news. New York. v. 59. June 19, 1908.
Prevost-Murphy, H. M. The moisture in the atmosphere and its effect on the operation of compressed air machinery, especially air-brake, multiple-unit train control and train signal systems. p. 659–663.

Engineering news. New York. v. 60. July 9, 1908.
Creighton, E. E. F. Measurements of lightning, lightning arresters, earth-resistances, and kindred tests. [Abstract]. p. 44–45.

Experiment station record. Washington, D. C. v. 19. April, 1908.
—— Meteorology of the Transvaal. [Abstract of part of work by Praagh.] p. 711.

Forestry and irrigation. Washington, D. C. v. 14. July, 1908.
—— Government to study shelterbelts for benefit of farming interests. p. 399–401. [Describes study of windbreaks and shelterbelts to be undertaken by the U. S. Forest service.]

Meteorological society of Japan. Journal. Tokio. v. 27. May, 1908.
H. I. H. Prince Yamishina. Necrology.

Geographical journal. London. v. 31. June, 1908.
Rickmers, W. R. The climatology of west Turkestan. p. 647. [Review of work by H. von Ficker.]

Physical review. Lancaster. v. 26. June, 1908.
Zeleny, John. The influence of humidity upon the electrical discharge from points in the air. p. 448–453.
Allen, S. J. Radioactivity of a smoke-laden atmosphere. p. 483–486.
Nichols, Edward L. Theories of the color of the sky. p. 497–511.

Royal society of London. Proceedings. London. ser. A. v. 80. June 20, 1908.
Mallock, A. Note on the ascent of meteorological balloons and the temperature of the upper air. 530–534.
Wilson, C. T. R. On the measurement of the atmospheric electric potential gradient and the earth-air current. p. 537–547.
Mallock, A. Effect of a cross wind on rifled projectiles. p. 595–597.
Ramsay, William. Percentage of the inactive gases in the atmosphere: a correction to previous calculations. p. 599.

Science abstracts. London. v. 11. June 25, 1908.
W[ilkinson], A. Bohne aneroid. p. 313. [Abstract of article by Schreiber.]

Scottish geographical magazine. Edinburgh. v. 24. July, 1908.
Mossman, R. C. The South Orkneys in 1907. p. 348–355. [Description of the meteorological work.]

Symons's meteorological magazine. London. June, 1908.
Bonacina, L. C. W. The glamour of the cumulus. p. 87–89.

Ciel et terre. Bruxelles. 29me année. 16 juin 1908.
Vanderlinden, E. Météorologie et tribunaux. p. 186–191.
Vanderlinden, E. La conductibilité électrique des arbres. p. 198–199.

France. Académie des sciences. Comptes rendus. Paris. Tome 146.
Deprez, Marcel. Sur le planement des oiseaux. (13 avril 1908.) p. 797–800.
Bloch, Eugéne. Sur l'ionisation de l'air par la lumiére ultraviolette. (27 avril 1908.) p. 892–898.
Garrigou-Lagrange, Paul. La pluie et la régime des cours d'eau. (22 Juin 1908.) p. 1353–1355.

Géographie. Paris. Tome 17.
Rabot, Charles. La pluviosité en octobre 1907 dans le midi de la France. (15 janvier 1908.) p. 41–42.

Journal de physique. Paris. Tome 7. Juin 1908.
Villard, M. P. Les rayons cathodiques et l'aurore boréale. p. 429–453.
Mathias, M. E. La physique des courants d'air d'après M. Shaw. p. 463–475.

Gaea. Leipzig. 44. Jahrgang. July 1908.
Müllermeister, Otto. Meteorologisches Glaubensbekenntniss. p. 388–392.

Mitteilungen aus den deutschen Schutzgebieten. Berlin. 21. Band. 1908.
—— Die Resultate der Regenmessungen in Togo im Jahre 1907. p. 140–145.

Physikalische Zeitschrift. Leipzig. 9. Jahrgang.
Kähler, Karl. Registrierung der Niederschlagselektrizität mit dem Benndorf-Elektrometer. (15. April 1908.) p. 258–260.

Weltall. Berlin. 8. Jahrgang.
Archenhold, F. S. Ueber ein sechsstündiges Gewitter und einen ausserordentlichen Hagelfall am 22 Mai 1908. (1. Juni 1908.) p. 265–269.

Wiener Luftschiffer-Zeitung. Wien. 7. Jahrgang. Juni 1908.
Hildebrandt, A. Ballonforschungen im Eismeere. (Die aëronautisch-meteorologische Schiffsexpedition Hewald-Hildebrandt nach Island, in das nördliche Eismeer und in den Atlantischen Ozean.) p. 97–98.
Fonvielle, Wilfrid de. Die Temperatur in hohen Regionen. p. 119–120.

Reale accademia dei Lincei. Atti. Roma. v. 17. 1. sem. Fasc. 8.
Zappa, Giovanni. Contributo alla spiegazione degli aloni: la deviazione minima con reflessioni interne nei cristalli. p. 519–531.

AN ANNOTATED BIBLIOGRAPHY OF EVAPORATION.[1]

By MRS. GRACE J. LIVINGSTON. Dated Washington, D. C., January 8, 1908.

INTRODUCTION.

The aim of the bibliographer has been not merely to give a list of the titles of publications bearing on or referring to the subject of evaporation, but to set before the reader a sufficiently full summary of each reference, so far as it has been accessible, so that the actual work need not be consulted except in cases where the fullest information is required. Articles bearing on the subject from the point of view of the meteorologist, the agriculturist, the irrigation and hydraulic engineer, have been included wherever found. Hygrometry, however, has been regarded as a distinct subject and only articles which deal with the subject in a general way, or which relate it in any way to the measurement of evaporation have been included. Evaporation from plants, or transpiration, has not been specifically included, as that subject has been so thoroly reviewed by Burgerstein, Transpiration der Pflanzen.

The subject thus restricted has been interesting, mainly

[1] This bibliography is published at the urgent request of many investigators who have examined the manuscript. It has not been practicable to verify all the formulas and references nor to insert any illustrative figures.—*C. A.*

historically, as showing a development similar to that in all sciencies, from the theoretical and vague to the experimental and definite. Until the beginning of the nineteenth century the attention of men of science was centered almost entirely on philosophical discussions of the physical nature of the phenomenon. There were, with one or two exceptions, no attempts to devise instruments for actually measuring the rate which might be expected under given conditions, or for relating the amount to other measured phenomena. Dalton, at the very beginning of the nineteenth century, may be regarded as the first to give definite direction to the interest already aroused in this subject, and by his researches to have laid the foundation for all future work along this line. The impetus thus furnished, fostered in the latter half of the century by such an enthusiast as G. J. Symons, has lasted to the present time. The simple laws which he pointed out have been the starting point for all the work undertaken by later mathematicians who have attempted to show definite relations between evaporation and the meteorological elements which influence and determine it.

The bibliographical study has been interesting secondarily as showing the actual degree of knowledge which has been obtained regarding the subject in all its relations, and finally as pointing out the direction in which further investigation must be conducted in this "most desperate branch of the most desperate science, meteorology."

Acknowledgments are gratefully extended to the officials of the Library of the Weather Bureau at Washington, D. C., and of John Crerar Library at Chicago, where this work has been mostly pursued, for their courtesy in granting free access to their shelves. For the inspiration of the work and for the use of a MS. bibliography of this subject including titles up to 1884 the bibliographer is deeply indebted to Prof. Cleveland Abbe, the Editor of the MONTHLY WEATHER REVIEW

LIST OF ABBREVIATIONS FOR TITLES OF PERIODICALS.

Amer. jour. sci.	American journal of science. New Haven, Conn.
Amer. met. jour.	American meteorological journal. Boston, Mass.
Amer. nat.	The American naturalist. Boston, Mass.
Ann. agron.	Annales agronomiques. Paris.
Ann. chim. et phys.	Annales de chimie et de physique. Paris.
Ann. école nat. agr. Montpellier.	Annales de l'école nationale d'agriculture de Montpellier. Montpellier, France.
Ann. inst. met. Roumania.	Annales de l'institut météorologique de la Roumanie. Bucharest.
Ann. Landw.	Annalen der Landwirtschaft in den preussischen Staaten. Berlin.
Ann. ofic. met.	Annales de la oficina meteorologica Argentina. Buenos Aires.
Ann. Phys.	Annalen der Physik. Halle.
Ann. Phys. und Chem.	Annalen der Physik und Chemie. (Poggendorf) Berlin; (Wiedemann) Leipsic.
Ann. ponts chauss.	Annales des ponts et chaussées. Paris.
Ann. rpt. Smithsn. inst.	Annual report of the board of Regents of the Smithsonian institute. Washington.
Ann. sci. ind.	Annal scientifique et industrielle. Paris.
Ann. soc. agr. Lyon.	Annales de la société d'agriculture, histoire naturelle, et arts utiles, de Lyon. Lyon, France.
Ann. soc. mét.	Annuaire de la société météorologique de France. Paris.
Ann. uffic. cent. met. Ital.	Annali dell'ufficio centrale di meteorologia italiana. Turin.
Anz. k. Akad. Wissen. (Wien.)	Kaiserliche Akademie der Wissenschaften. (Wien.) Mathematisch-naturwissenschaftliche Klasse. Anzeiger. Vienna.
Arch. med. Aarau.	
Arch. sci. phys. et nat.	Archives des sciences physiques et naturelles. Geneva.
Athen.	Athenaeum. London.
Atti. accad. pont. nuovi Lincei.	Atti del l'accademia pontificia dei nuovi Lincei. Rome.
Atti r. accad. Lincei.	Atti della reale accademia dei Lincei. Rome.
Atti soc. veneto-trentina sci. nat.	Atti della societa veneto-trentina di scienze naturali. Padua.
Bayer. met. ephem.	Königliche bayerische Akademie der Wissenschaften. Meteorologische ephemeriden. Munich.
Bibl. ital.	Biblioteca italiana. Milan. (ossia giornale di letteratura, etc.)
	Biblioteca italiana, ou Tableau des progrès des sciences et des arts en Italie. Turin.
Bibl. univ.	Bibliothèque universelle de Génève. Geneva.
Bol. soc. geog. Lima.	Boletín de la sociedad geográfica de Lima. Lima, Peru.
Boston jour. phil. arts.	Boston journal of philosophy and the arts. Boston, Mass.
Brit. rainf.	British rainfall. London.
Bul. acad. imp. sci.	Bulletin of the imperial academy of sciences. St. Petersburg.
Bul. acad. sci. de Belgique.	Bulletin de l'académie royale des sciences, des lettres, et des beaux arts de Belgique. Brussels.
Bul. assoc. sci. de France.	Bulletin de l'association scientifique de France. Paris.
Bul. dir. agr. et com. (Tunis.)	Bulletin de la direction de l'Agriculture et du Commerce. Tunis.
Bul. int. de l'obs. de Paris.	Bulletin internationale de l'Observatoire de Paris. Paris.
Bul. mens. obs. phys. cent.	Bulletin mensuel de l'observatoire physique central de Montsouris. Montsouris, France.
Bul. mét. Hérault.	Bulletin météorologique du département de l'Hérault. Montpelier, France.
Bul. soc. philom.	Société philomathique de Paris. Annual bulletin. Paris.
Bul. soc. vaud. sci. nat.	Bulletin de la société vaudoise des sciences naturelles. Lausanne.
Carnegie Inst. Washington, Pub.	Carnegie institute of Washington publications. Washington.
Centbl. Agr. Chem.	Centralblatt für das gesammte Forstwesen. Vienna.
Chem. Ann.	Chemische Annalen für die Freunde der Naturlehre. Helmstädt, Germany.
Chem. Centbl.	Chemisches Centralblatt. Leipsic.
Ciel et Terre.	Ciel et Terre. Brussels.
Coll. acad. franç.	Collection académique, partie française. Dijon and Paris.
Comment. acad. sci. imp. Petrop.	Commetarii academiae scientiarum imperialis Petropolitanae. St. Petersburg.
Compt. rend.	Comptes rendus hebdomadaires des séances de l'Académie des Sciences. Paris.
Dingler's polytech. Jour.	Dingler's polytechnisches Journal. Stuttgart.
Edinb. encycl.	
Edinb. new phil. Jour.	Edinburgh new philosophical journal. Edinburgh.
Edinb. phil. jour.	Edinburgh philosophical journal, Edinburgh.
Engin. rec.	Engineering record, building record, and sanitary engineer. New York.
Essays obs. phys. lit.	Essays and observations, physical and literary, read before the philosophical society in Edinburgh. 2 vols. (I, II), 8vo., Edinburgh, 1754–56. Vol. III, 1771.
Exp. sta. bul.	U. S. department of agriculture, office of experiment stations. Bulletin. Washington.
Exp. sta. rec.	U. S. department of agriculture, office of experiment stations. Record. Washington.
Forsch. Geb. Agr. Phys.	Forschungen auf dem Gebiete der Agrikultur-Physik. Heidelberg.
Fortsch. f. Met.	
Fortsch. der Phys.	Fortschritte der Physik. Berlin.
Franklin inst. jour.	Journal of the Franklin institute. Philadelphia.
Gaea.	Gaea, Natur und Leben. Cologne.
Geog. Abh.	Geographische Abhandlungen. (Penck), Vienna.
Geog. jour.	Geographical journal. London.
Gior. fis. chim.	Giornale di fisica, chimica, storie naturale, medicina ed arti. Pavia.
Gior. sci. nat.	Giornale di scienze, naturali ed economiche. Palermo.
Glean. sci.	Gleanings in science. Calcutta.
Hist. acad. sci.	Histoire de l'académie royale des sciences. Paris.
Illus. Ztg.	Illustrierte Zeitung. Leipsic.
Izv. Moscov. Selsk. Khoz. Inst. (Ann. inst. agron. Moscou).	Izviestia Moskovskoie Sel skokhozyaistvennei. (Annales de l'institut agronomique de Muscou.) Moscow.

Jahrb. tellur. Obs. Bern.	Jahrbücher des tellurischen Observatoriums zu Bern. Bern.
Jour. agr. prat.....	Journal d'agriculture pratique. Paris.
Jour. agr. sci.....	The Journal of agricultural science. Cambridge, England.
Jour. Amer. chem. soc.	Journal of the American chemical society. Easton, Pa.
Jour. Asiat. soc. Bengal.	Journal of the Asiatic society of Bengal. Calcutta.
Jour. Chem. Phys....	Journal für die Chemie und Physik. (Schweigger), Nuremberg, Germany.
Jour. chem. soc.....	Journal of the chemical society. London.
Jour. de phys. Paris..	Journal de physique théorique et appliqué. Paris.
Jour. dept. agr. So. Aust.	Journal of the department of agriculture of South Australia. Adelaide.
Jour. Landw.....	Journal für Landwirtschaft. Berlin.
Jour. mines.....	Journal des mines. Paris.
Jour. nat. phil. chem.	Journal of natural philosophy, chemistry, and the arts. (Nicholson's), London,
Jour. Phys. Leipsic..	Journal de Physik. Leipsic.
Jour. phys. Paris....	Journal de physique, de chimie, d'histoire naturalle et sur les Arts. Paris.
Jour. roy. agr. soc....	Journal of the royal agricultural society of England. London.
Jour. roy. geog. soc..	Journal of the royal geographical society of England. London.
Jour. Russ. phys. chem. soc.	Journal of the Russian physico-chemical society. St. Petersburg.
Jour. soc. arts.....	Journal of the society of arts. London.
K. bayer. Akad. der Wiss. Munich, Gelehrte, Anz.	Königliche bayerische Akademie der Wissenschaften. Gelehrte Anzeigen. Munich.
L'atmosphere	.....
Lotos	Lotos. Zeitschrift für Naturwissenschaften-Prague.
Les mondes..:.....	Les mondes. Paris.
Madras jour. lit. sci..	Madras journal of literature and science. Madras.
Mag. f. neu. Zustand Naturk.	Magazin für den neuesten Zustand der Naturkunde. Jena and Weimar.
Mag. neu. Phys. und Naturgesch.	Magazin für das neueste aus der Physik und Naturgeschichte. Gotha.
Mannheim ephem....	Societas meteorologica palatina. Ephemerides. Mannheim.
Med. repos	Medical repository. New York.
Mél. phys. et chem...	Mélanges physiques et chimiques. St. Petersburg.
Mém. acad. sci	Mémoires de l'académie royale des sciences. Paris.
Mém. inst. nat. sci. et arts.	Mémoires de l'institute national des sciences et arts. Paris.
Mem. lit. phil. soc ...	Memoirs of the Manchester literary and philosophical society. Manchester, England.
Mem. met. ital.....	Memorie meteorologica Italiana. Rome.
Men. r. accad. Torino	Memorie della reale accademia di Torino. Turin.
Mem. reg. accad. sci. Modena.	Memorie della regia accademia di scienzi, lettere ed arti in Modena. Modena, Italy.
Mem. soc. agric. Orleans.	Société royal d'agriculture, des sciences, belleslettres et arts. Mémoires. Orleans.
Mem. soc. ital. sci ...	Societa italiana della scienze. Memorie. Naples. Rome.
Mém. soc. sci. phys. et nat. Bordeaux.	Mémoires de la société des sciences physiques et naturelles de Bordeaux. Paris.
Met. Soc. Rep	
Met. ital. sup	Meteorologia Italiana. Rome. Supplemento alla Meteorologia Italiana.
Met. Jahrb. Jena.....	Meteorologische Jahrbücher. Jena.
Met. Zeits.....	Meteorologische Zeitschrift. Braunschweig, Germany.
Mitt. forstl. Versuchsw. Ost.	Mittheilungen aus dem forstlichen Versuchswesen Oesterreichs. Vienna.
Mitt. schweiz. Centralanst. Forsti. Versuchsw,	Mittheilungen der schweizerischen Centralanstalt für das forstliche Versuchwesen. Zürich.
Monit. sci	Le moniteur scientifique. Paris.
Mo. weather rev	U. S. Weather Bureau, Monthly weather review. Washington.
München Sternw. Wochenbl.	Annalen der königlichen Sternwarte bei München. Wochenblatt. Munich.
Nat. geog. mag	National geographic magazine. Washington.
Nature	Nature. London.
Naturw. Abh	Naturwissenschaftliche Abhandlungen.
Neu. allg. Jour. Chem.	Neues allgemeines Journal der Chemie. Leipsic.
Neu. Hamburg Mag..	
Notiz. Geb. Nat. u. Heilk.	Notizen aus dem Gebiete der Natur- und Heilkunde. (Froriep.) Erfurt, Weimar, Jena.
Nouv. mét.....	Nouvelles météorologiques. Paris.
Nuovo cimento	Nuovo cimento, giornale di fisica, chimica, e storie naturali. Pisa and Turin.
Novi comment. acad. sci. imp. Petrop.	Academia scientiarum imperialis petropolitana. Novi commentarii. St. Petersburg.
Obs. phys.....	Observations sur la physique, sur l'histoire naturelle, et sur les arts. Paris.
Öfvers. k. Svenska. förhandl.	Öfversigt of kongliga Svenska vetenskaps-akademiens förhandlingar. Stockholm.
Oest. landw. Wochenbl.	Oesterreichisches landwirtschaftliches Wochenblatt. Vienna.
Phil. mag.....	London, Edinburgh, and Dublin philosophical magazine and journal of science. London.
Phil. trans.....	Philosophical transactions of the Royal Society of London. London.
Phys. rev. (London)..	.....
Poligrafo	Poligrafo. Verona.
Proc. Amer. forestry assoc.	Proceedings of the American forestry assoc.
Proc. Ashmol. soc....	Ashmolean society. Abstract of the proceedings. Oxford.
Proc. Asiat. soc. Bengal.	Proceedings of the Asiatic society of Bengal. Calcutta.
Proc. Brit. met. soc..	Proceedings of the British meteorological society. London.
Proc. inst. civ. engin.	Proceedings of the institute of civil engineers. London.
Proc. roy. Irish acad.	Proceedings of the royal Irish academy. Dublin.
Proc. roy. soc. Edinb.	Proceedings of the royal society of Edinburgh. Edinburgh.
Proc. roy. soc. London	Proceedings of the royal society. London.
Quart. jour. roy. met. soc.	Quarterly journal of the royal meteorological society. London.
Quart. jour. sci.....	Quarterly journal of science, literature and the arts. London.
Rap. ann. sta. agron. Mauritius.	Colony of Mauritius. Station agronomique. Rapport annuel. Mauritius.
Rpt. Chf. Eng.....	U. S. War Department, Annual Report of the Chief of Engineers. Washington.
Rend. r. ist. Lomb...	Reale instituto lombardo di scienze lettere. Rendiconti. Milan.
Repert. der Phys.....	Repertorium der Physik. (Carl) Munich.
Repert. f. Met.....	Repertorium für Meteorologie. (Wild) St. Petersburg.
Repert. f. Met. Dorpat	Repertorium für Meteorologie. (Kämtz) Dorpat.
Rev. sci.....	Revue scientifique. Paris.
Rev. soc. sav.....	Revue des sociétés savantes. Paris.
Riv. sci. ind	Rivista scientifico industriale. Florence, Italy.
Rpt. Brit. assoc. adv.	Report of the British association for the advancement of science. London.
Samml. Deut. Abh. Akad.	.....
Schweiz. met. Beob..	Schweitzerische meteorologische Beobachtungen. Zürich.
Sci. Amer.....	Scientific American. New York.
Sci. Amer. sup.....	Scientific American, supplement. New York.
Science.....	Science. NewYork.
Sci. mem.....	Scientific memoirs (Taylor.) London.
Sci. pour tous.....	La science pour tous. Paris.
Sci. proc. roy. Dublin soc.	Scientific proceedings of the royal Dublin society. Dublin.
Scot. geog. mag.....	Scottish geographical magazine. Edinburgh.
Sitzber. k. Akad. Wiss. (Vienna) Math. Naturw. Kl.	Sitzungsberichte der kaiserlichen Akademie der Wissenschaften, Mathematisch-Naturwissenschaftliche Klasse. Vienna.
Sitzber. k. bayer. Akad Wiss. Math. Phys. Kl.	Sitzungsberichte der königlichen bayerischen Akademie der Wissenschaften, Mathematisch-Physikalische Klasse. Munich.
Sitzber. k. böhm. Ges. d. Wiss., (Prag).	Sitzungsberichte der kaiserlichen böhmischen Gesellschaft der Wissenschaften. Prague.
Smiths. misc. coll....	Smithsonian Institution. Miscellaneous collections. Washington.
Svenska vetensk. akad Handl.	Königl. svenska vetenskaps Akademi Handlingar. Stockholm.
Symons' met. mag...	Symons' meteorological magazine. London.
Tidskr. math. fys....	Tidskrift för mathematik och fysik. Upsala.

Trans. Amer. phil. soc.	Transactions of the American philosophical society. Philadelphia.
Trans. Amer. soc. civ. engin.	Transactions of the American society of civil engineers. New York.
Trans. Bombay geog. soc.	Transactions of the geographicl society of Bombay. (Bombay.)
Trans. N. Y. State agr. soc.	Society instituted in the State of New York for the promotion of agriculture, arts, and manufactures. Transactions. Albany.
Trans. roy. Irish acad.	Transactions of the royal Irish academy. Dublin.
Trans. roy. Scot soc. arts.	Transactions of the royal Scottish society of arts. Edinburgh.
Trans. So. African phil. soc.	Transactions of the South African philosophical society. Cape Town.
Utr. Aanteek. prov. genoots.	Provincial utrechtsch genootschap van kunsten, en wetenschappen. Aanteekeningen van het verhandelde in de sectie-vergaderingen. Utrecht.
Van Nostrand's engin. mag.	Van Nostrand's engineering magazine. New York.
Water sup. and irr. papers.	U. S. Geological Survey. Water supply and irrigation papers. Washington.
Wittenberg Wochenbl.	Wittenbergisches Wochenblatt zum Aufnehmen der Naturkunde und des oekonomischen Gewerbes. Wittenberg.
Woburn exp. fruit farm rpt.	Woburn experimental fruit farm. Reports. London.
Zeits. Arch. Ver.....	Zeitschrift des Architecten und Ingenieur Vereins. Hannover, Germany.
Zeits. Deut. geolog. Ges.	Zeitschrift der Deutschen geologischen Gesellschaft. Berlin.
Zeit. Gewässerk.....	Zeitschrift für Gewässerkunde. Leipsic.
Zeits. f. Naturw. Halle.	Zeitschrift für die gesammten Naturwissenschaften. Halle.
Zeits. Oest Ges. Met.	Zeitschrift der Oesterreichischen Gesellschaft für Meteorologie. Vienna.
Zhur. opuitn. agron. (Russ. Jour. exp. Landw.)	Zhurnal opuitnoi agronomii. (Russisches Journal für experimentelle Landwirtschaft. St. Petersburg.

1670.

Perrault, Claude.

Observations sur l'évaporation de l'eau et sur l'effet du froid sur different huiles. (1670.) Hist. acad. sci., 1666–86, 1:115–6. (1733.)

Various liquids were exposed to evaporation during cold weather. Water evaporated considerably, oils of bitter almonds, olives, aniseed, walnut, and turpentine evaporated a little, and linseed oil and oil of sweet almonds none at all.

1687.

Halley, Edmund.

An estimate of the quantity of vapor raised out of the sea by the warmth of the sun, derived from an experiment shown before the Royal Society. Phil. trans., 1687, 16:366–70; also abridged in Phil. trans., abridged, 1683–94, 3:387–90. (1809.)

A salt solution of the concentration of ordinary sea water (1:40), lost by evaporation at the rate of 0.1 inch in 12 hours. From this it was calculated that the amount evaporated from the Mediterranean in a summer day is at least 5,280 millions of tons. The accelerating influence of wind on evaporation was observed.

1690.

Halley, Edmund.

An account of the circulation of the watery vapors of the sea, and of the cause of the springs. Phil. trans., 1690, 17:468–73; also abridged in Phil. trans., abridged, 1683–94, 3:327–30. (1809.)

Advances the theory that evaporation is partly cause by heat expanding water particles into hollow shells lighter than air. Suggests that the air imbibes a certain quantity of aqueous vapor and retains it "like salts dissolved in water."

1692.

Sedileau.

Observations sur la quantité de l'eau de pluie tombée à Paris, durant près de trois année, 1686–90, et de la quantite de l'évaporation. (1692.) Mem. acad. sci., 1666–99, 10:27–36 (1730); also Hist. acad. sci., 1686–99, 2:63, 87, 133–5; also Coll. acad. franç., 1754, 1:257–61.

An experiment carried on from June, 1688, to December, 1690, with evaporation of water showed an average annual amount at Paris of 32.1 inches. The annual rainfall was 19 inches. The rate was found to be higher from small vessels than from larger ones.

1694.

Halley, Edmund.

An account of the evaporation of water, as it was experimented in Gresham College in the year 1693, with some observations thereon. Together with a table showing the quantity evaporated each day, with the heights of the thermometer and barometer. Phil. Trans., 18:183–90 (1694); also Phil. trans., abridged, 1683–94, 3:658–9. (1809.)

The low annual evaporation rate of 8 inches, observed from water not exposed to sun and wind, as compared to the annual rainfall of 19 inches at Paris or 40 inches near Lancaster, is believed to show that the sun and wind, especially the wind, are the important factors influencing evaporation.

1709.

Gauteron.

Observations sur l'évaporation qui arrive aux liquides pendant le grand froid, avec des remarques sur quelues effets de la gelée. Mém. acad. sci. 1709, (—):451–71.

An ounce of water allowed to freeze and exposed from 6 p. m. to 8 a. m., lost 24 grains by evaporation. A comparative experiment with various liquids at a low temperature resulted as follows: Ice lost 36 grains; walnut oil, not frozen, 40 grains; brandy and oil of turpentine, not frozen, 54 grains each. Mercury and olive oil were unchanged by the exposure.

1712.

Müller, Johann Heinrich.

Exercitatio. De exhalationibus, tamquam proxima meteorum materia. (Joa. Müller resp.) 4to. Altorfiæ. (Altdorf.) 1712.

1715.

Barlow, E.

Meteorological essays. London. 1715.

"How Vapors, raised by the Sun to several Heights in the Air, grow, by their Descents, condensed into Rain, and Hail, of divers sorts." p. 43–48.

1729.

Desaguliers, Jean Théophile.

An attempt to solve the phenomenon of the rise of vapours, the formation of clouds and the descent of rain. Phil. trans., No. 407, 36:6 (1729); also Phil. trans., abridged, 1724–34, 7:323–31.

The theory expounded by Dr. Niewentyt and others, (see Niewentyt's Religious Philosopher, Contemplation 19, Sections 13–25) that particles of fire separate from sunbeams and combine with particles of water to make molecules specifically lighter than air, wherefore they rise until the air about them is of the same specific gravity as themselves, and that rain is produced by the separation of these particles of fire and water, is objected to on the ground that fire has not been proven to be a distinct element, and that the causes of rain given are contrary to experience. Experimental evidence is presented, favoring the idea that heat gives elasticity to fluids, causing the particles to exert a force of expansion at great distances. Refers to the work of Halley, (1687, 1690, 1694.)

1732.

Musschenbroek, Petro Van.

Ephemerides meteorologicæ, barometricæ, thermometricæ, epidemicæ, magneticæ, ultrajectinæ. Phil. trans., 37:357–84. (1732.)

Evaporation for the year from a free surface of water was 32 in. 2.75 lines, (Rh.),[2] with a rainfall of 25 in., 1.25 lines, (Rh.).

1734.

Du Fay.

Observations météorologiques faites à Utrecht, pendant l'année 1734, extraites d'une lettre de M. Musschenbroek. Mém. acad. sci., 1734, (—):564–6.

The evaporation for the year 1734 at Utrecht was 25 in., 3 lines (Rh.), and the rainfall was 35 in., 11 7/9 lines (Rh.). The annual average rainfall at Paris is taken as 24 in. (Rh.).

1735.

Du Fay.

Observations météorologiques faites à Utrecht, pendant l'année 1735, extraites d'une lettre de M. Musschenbroek. Mém. acad. sci., 1735, (—):581–4.

Evaporation was 23 inches, 2 lines; the rainfall was 26 inches, 1½ lines (Rh.).

1736.

Du Fay.

Observations météorologiques faites à Utrecht, pendant l'année 1736, extraites d'une lettre de M. Musschenbroek. Mém. acad. sci., 1736, (—):503–5.

Evaporation was 28 inches, 11 lines (Fr.), with a rainfall of 22 inches, 9½ lines (Fr.).

1741.

Bazin.

Observation sur l'évaporation de l'eau. (Communicated by M. de Réaumur.) Hist. acad. sci., 1741, (—):17–19.

Evaporation was found to be more rapid from moist potter's clay than from a free water surface. It is suggested that this may be due to the difference between the temperatures of the two substances and somewhat to the inequalities of the surface of the soil.

1742.

Bouillet, Jean.

Sur l'évaporation des liquides. Hist. acad. sci., 1742, (—):18–21.

The theory that the circular motion of fluids causes the particles at the surface to pass off tangentially is considered a sufficient explanation for the fact of evaporation. The process is regarded as a solution of these particles in air.

1743.

Stock, J. C.

Dissertatio. De exhalationibus sive effluviis. (Joa. Jac. Algoewer resp.) 4to. Jenae. 1743.

1744.

Kratzensteins, Christian Gottlieb.

Théorie de l'élévation des vapeurs et des exhalaisons, démontrée mathématiquement. 4to. Bordeaux. 1745.

Abhandlung vom Aufsteigen der Dünste und Dämpfe, welche von der Akademie zu Bordeaux den Preis erhalten. Halle. 1744. (Translation of the above.)

[2] Rhenish measure is indicated by (Rh.) and french measure by (Fr.). The rhenish foot was to the french foot as 139:144.—*G. J. L.*

According to Saussure (1783), Kratzenstein estimated the vapor vesicles thrown off by evaporation as being of the diameter of a hair.

Richmann, Georg Wilhelm.

Qua ratione instrumentum, quo quantitas aquae, calore atmosphaerae naturali ex superficie aquae certa in aerem elevatae commode mensuratur, construi debeat. Comment. acad, sci. imp. Petrop., 1744–6, 14:273–5.

Describes an instrument for measuring evaporation, in which the vessel containing the evaporating water is partially sunk in a larger closed vessel also containing water.

1746.

Wallerius, Nils.

Rön, Hvarigenomåtskilliga Naturens lagar, angående Vattnets och andra flytande Materiers utdunstande, frambringas. Svenska vetensk. Akad. Handl. 1746, 7:1–21, 145–76.

See German translation 1752.

1747.

Richmann, G. W.

Inquisitio in legem, secundum quam calor fluidi in vase contenti, certo temporis intervallo, in temperie aeris constanter eadem decrescit vel crescit et detectio ejus, simulque thermometrorum perfecte concordantium construendi ratio hinc deducto. Novi comment. acad. sci. imp. Petrop., 1747–8, 1:174–197. Summ., 50–51.

The law deduced from observations is that the variations in the temperature of water, relative to that of the surrounding air, are directly proportional to the surfaces exposed and to the differences between the temperatures of the water and the air, and inversely to the masses. Hence the differences between the temperatures of the air and the water decrease in geometrical progression if the time intervals succeed each other in arithmetical progression.

Richmann, G. W.

Tentamen, legem evaporationis aquæ calidæ in ære frigidiori constantis temperiei definiendi. Novi comment. acad. sci. imp. Petrop., 1747–8, 1:198–205; Summ., 51.

Observations on evaporation of warm water in colder air of a constant temperature, seemed to show that the quantity evaporated is proportional to the successive differences of the differences between the temperature of the water and that of the air.

Richmann, G. W.

Tentamen explicandi phenomenon paradoxon, scilicet thermometro mercuriali ex aqua extracte mercurium in ære, aqua calidiori, descendere et ostendere temperiem minus calidam ac æris ambientis est. Novi comment. acad. sci. imp. Petrop., 1747–8, 1:284–290; Summ., 55.

As a thermometer is drawn from water into air warmer than the water, the temperature indicated continues to fall because the evaporation of the thin layer of water clinging to the bulb of the thermometer cools it.

1751.

Le Roy.

Mémoire sur l'élévation et la suspension de l'eau dans l'air, et sur la rosée. Mém. acad. sci., 1751, (—):481–518.

Observations and experiments are cited to prove the theory that the solution of water in air follows the same laws as solutions of salts in water and other solutions.

Richmann, G. W.

Atmometri sive machinæ hydrostaticæ ad evaporationem aquæ certæ temperiei mensurandam aptæ constructio talis, ut ope ilius decrementum paucorum granorum observari et lex evaporationis confirmari possit. Novi comment. acad. sci. imp. Petrop., [1749–50], 2:121–27; Summ., 9. (1751.)

A closed cylindrical air chamber slides between stationary vertical rods inside of a larger covered vessel containing water. From the upper wall of the air chamber three small rods project vertically thru holes in the cover of the outer vessel and form the support for the metal evaporating vessel. The total weight of the evaporating vessel and contents, the rods and the air chamber, are balanced by the weight of the water displaced by the submerged part of the system. Any loss in weight due to evaporation causes a corresponding rise of the evaporating vessel and can be calculated therefrom.

Richmann, G. W.

Inquisitio in rationem phænomeni, cur aqua profunda in vasis homogenæ materiæ plus evaporet quam aqua minus profunda, et confirmatio experimento nova ratione instituto. Novi comment. acad. sci. imp. Petrop., [1749–50], 2:134–44. (1751.)

Experiments with evaporation from water surfaces at different depths in vessels of similar material showed that less evaporation takes place from the shallower water. The cause of this seems to lie in the observation that if the ratio of the whole surface of the larger mass to the whole surface of the smaller is less than the ratio of the greater mass to the lesser mass, then the latter assumes the temperature of the air more quickly than does the former, and vice versa. This is not believed to be applicable to large natural bodies of water, since many complicating differences arise.

Richmann, G. W.

De evaporatione ex aqua frigidori aere observationes et consectaria. Novi comment. acad. sci. imp. Petrop., [1749–50], 2:145–61; Summ., 11–13. (1751.)

Experiments with evaporation from water colder than the air above it showed the following relations: Condensation, and not evaporation, occurs when the temperature of the air is between 60° and 70° F. if the temperature of the water is more than 15° below it, and also when the temperature of the air is between 75° and 87° if the water is 20° colder. A discussion of the application of these facts to general meteorology follows.

1752.

Wallerius, Nils.

Versuche, wodurch verschiedene Gesetze der Natur die Ausdunstung des Wassers und anderer flüssigen Materien betreffend, entdecket werden. Svenska vetensk. akad. Handl., 1746, 7:1–21, 145–176, Uebersetzt von A. G. Kästner. Hamburg. 1752.

Describes experiments with a weighing evaporometer extending thru 5 years, from which the following laws are deduced: Evaporation is proportional to the surface in contact with the air; increased temperature increases evaporation; increased movement of the air increases evaporation. The addition of salt (NaCl) and saltpeter (KNO_3) to water hindered evaporation at first but not finally. This initial decrease is believed to be due to the cold produced upon the addition of the salt. Sugar and vitriol were used as solutes without the retarding effect. Milk evaporated as rapidly as water until the cream was formed, when the rate decreased. Alcohol, wine and olive oil were also experimented with.

1753.

Baron.

Expériences sur l'évaporation de la glace. Mém. math. phys. acad. sci., 1753, (—):250–68.

Discusses the fact shown by Sedileau and Mariotte, and later confirmed by Gauteron and Mairan, that ice evaporates. In January, 1753, Baron's experiments showed that ice always evaporates more or less, but not proportionally to the coldness of the air. He considers that the phenomenon is due to the blowing off of fine particles of water by the wind, and that it is "not true evaporation."

1756.

Franklin, Benjamin.

Physical and meteorological observations, coniectures, and suppositions. Read June 3, 1756. Phil. trans., 55:182–92.

Considers evaporation a chemical solution of water in air.

1757.

Franklin, B[enjamin].

Letter to John Lining, 1757. Published in his Complete Works, edited by John Bigelow, 1887; 2:498, and 3:22. Also translated in Obs. Phys., 1773, 2:453–7.

An experiment was repeated which had been described by Professor Simson of Glasgow, which consisted in keeping wet the bulb of a thermometer with alcohol and thereby producing a temperature several degrees lower than it would otherwise have. The cooling effect of evaporation is further discussed in 3:22.

1763.

Desaguliers, Jean Théophile.

A course of experimental philosophy. London. 1763. Lecture 10, Hydrostatiks, 2:249–374.

Discusses at length the nature of evaporation, refuting the idea that particles of fire unite with particles of water to lift them into the air; and the other idea that water in sunshine forms spheres with an "aura or finer air" inside which buoys them upward. Proposes the idea that heat increases the repellant force between the particles, a solid thus becoming a liquid and a liquid a gas.

1764.

Haller, Albrecht v.

Sur l'évaporation de l'eau salée. Mém. acad. sci., 1764, (—):9–74. Also abstracted in Hist. acad. sci., 1764, (—):25–31.

A salt solution was found to evaporate less rapidly as it became more concentrated. Gives tables of evaporation from salt water in large shallow basins from March to October in the years 1759–64, with the state of the sky, the average daily temperature, and the product in salt at the end of each experiment. From these observations the annual evaporation at the salt works of Bevaix in Switzerland is valued at 22 in., 1.25 lines.

1765.

Hamilton, Hugh.

A dissertation on the nature of evaporation and several phenomena of air, water, and boiling liquors. Phil. trans., 1765, 55:146–81. Also translated in Neu Hamburg Mag., 1767, 2:147–92.

Refutes all earlier theories which assign "rarefaction by heat" as the chief if not the only cause of evaporation. Considers the process to be nothing more than a gradual solution of water in air, produced and promoted by the same means—attraction, heat and motion—by which other solutions are affected. Gives experiments, observations, and discussion.

1766.

Hamilton, Hugh.

On the ascent of vapors, the formation of clouds, rain, and dew, and on several other phenomena of air and water. In his Philosophical Essays, 8vo, London, 1766; 2d ed., 12mo, 1767; 3d ed., 12mo, 1772; 4th ed., 12mo, 1783. Also in his Works, 2 vols., 8vo, London, 1809.

Same as article of 1765.

1770.

Lavoisier.

De la combinaison de la matière du feu avec les fluides évaporables, et de la formation des fluides élastiques aeriformes. Mém. acad. sci., 1770, (—):420–32.

The cooling produced by evaporation is advanced as proof of his theory that there is an absorption of "matière du feu" or "igneous fluid" in the formation of vapors, or that vapors are a result of the combination of the "matière du feu" with the fluid.

1771.

Kames, H. H.

On evaporation. Essays obs. phys. lit., 1771, 3:99. Also translated in Obs. phys., 1773, 2:97–104.

Further support is given to the theory that evaporation is a solution of water in air.

1773.

Gabler, P. M.

Theoria vaporum. 4to. Ingolstad. 1773.

1774.

Cotte, P.

Traité de Météorologie. 4to. Paris. 1774. xxxvi + 635.

Reviews various theories of evaporation, p. 39 et seq. Discusses (p. 61) evaporation from ice, quoting Gauteron (1709). Sedileau (1692), is quoted, p. 317. Cotte gives 28 inches as the amount of annual evaporation at Montmorenci, from two years' observations.

The size, nature, and exposure of the vessels employed are considered to have a marked influence on the rate of evaporation. He believes Musschenbroek showed that evaporation does not take place equally from two vessels of the same length and breadth but of different depths; it is more rapid from the deeper vessel. M. found that the cubes of the quantities evaporated from two vessels are to each other as the heights of the fluids in the vessels. (Additions de M. Musschenbroek aux expériences de l'Acad. del cimento in Collection académique, vol. 1 (part. étrang.): 142, n. d. Cotte also refers (p. 307) to a large number of experiments on evaporation of water and ice conducted by J. Broval (Mém. de l'Acad. de Stockholm), Hales (Vegetable Statics. London, 1726), Desaguliers (Cours de phys. expér., vol. 2, p. 343, translation of P. Pezenas), Musschenbroek (Cours de Phys., vol. 2, p. 301, translation of M. Sigaud de Labond).

1775.

Barker, Robert.

The process of making ice in the East Indies. Phil. trans., 1775, 65 (pt. 2):252–7. Also Phil. trans., abridged, 1770–76, 13:644–5.

The cooling produced by evaporation is taken advantage of in the East Indies where ice is made by leaving water in porous clay pans over night.

1777.

Dobson, Matthew.

Observations on the annual evaporation at Liverpool, in Lancashire; and on evaporation considered as a test of the moisture or dryness of the atmosphere. Phil. trans., 1777, 67:244–59. Also Phil. trans., abridged, 1776–80, 14;137–43. Also abstracted in Obs. phys., 1779, 13:81–5.

The rate of evaporation is considered to be a more accurate test of the moisture or dryness of the air than the quantity of rainfall. A table shows the mean monthly evaporation, rainfall, temperature, and velocity of the wind, and also a comparison of the evaporation rate for the different seasons of the years 1772–5. The annual evaporation at Liverpool, from four years' observations, is given at 36.78 in., with a rainfall of 37.43 in. Halley's experiments are referred to, (1687, 1690, 1694), also those of Cruquius, who observed an annual evaporation at Delft, of 30 inches from water set in the open air but not in the sun and wind. Experiments showing that evaporation did not take place from water placed in a vacuum seemed to prove that air is a chemical solvent of water and as such is an important cause of evaporation. Heat, when of a sufficient degree being another cause, may produce this effect without the intervention of air, the evaporation proceeding rapidly in an exhausted receiver as in the experiments of Dr. Irving in Phipp's Voyage to the North Pole, p. 211.

Hunter, Alex.

Georgical Essays. York, England. 1777. Essay VIII, On air dissolving water, p. 95–130.

Discusses the general facts and theory of evaporation. The author takes the position that evaporation is merely a form of solution, the water dissolving in the air.

1779.

Fontana, l'Abbé.

Mémoire sur l'évaporation des fluides dans l'air non renouvellé. Obs. phys., 1779, 13:32–38.

Experiments seem to show that the more volatile fluids such as ether, which evaporate so easily in the free air, do not evaporate at all when enclosed in air-tight vessels, and that even the action of heat upon these fluids does not increase the rate, proving that there is no sensible evaporation of liquids, although naturally volatile, if the air is not renewed.

1780.

Achard.

Dissertation sur la cause d'élévation des vapeurs. Obs. phys., 15:463–77. (1780.)

Supports the solution theory of evaporation.

Achard.

Mémoire sur le froid produit par l'évaporation. Obs. phys., 16:174–86. (1780.)

Quotes letter to Dr. Lining from B. Franklin (1757). Gives tables of results obtained from observations on the lowering of the temperature of many different liquids when subjected to evaporation.

Schotte, J. P.

Journal of the weather at Senegambia during the prevalence of a very fatal putrid disorder, with remarks on that country. Phil. trans., 1780, 70 (pt. 2):478–506.

The author refers (p. 486) to the enormous rate of evaporation at St. Louis, or Sénégal, 16° N. lat., 16° W. long., where the natives cool water in tanned leather bags hung in the open air. Also quoted by Watson, 1781.

1781.

Cotte, Louis.

Expériences sur les quantités d'évaporations relatives à la hauteur et au diamètre des vases qui servent à les mesurer. Obs. phys., 1781, 18:306–9; translated in Mag. neu. Phys. und Naturgesch., 1 (pt. 3):36–42. (1785.)

Experiments to determine the influence of the dimensions of the containing vessel on the rate of evaporation (cf. Cotte, 1774) show that evaporation has no relation to the height of the vessel, that it is not proportional to the volumes nor to the exposed amount of the interior surface of the walls, but that there is as much variety in the results as there is in the form of the vessels used.

Watson, Richard.

Chemical Essays. London. 1781. 5 vol. 12mo. 7th ed., 1800.

In volume 3, essay 2 (p. 51–74), the evaporation from an acre of "dry ground" is estimated to be over 1,600 gallons in 12 hours of a hot summer day, and more if the ground is moist. In essay 3 (p. 75–117) the process of evaporation is likened to the solution of salts in water. Essay 4 (p. 119–142) contains a discussion of the cooling produced by evaporation, as shown by experiments with the wet bulb thermometer, and by the methods employed in hot countries of cooling wine, water, etc., by wrapping wet cloths about the flasks, or by keeping them in porous jars or leather bags. He cites Professor Braun's table of the degrees of cold produced by the evaporation of different fluids (Novi comment. acad. sci. imp. Petrop., 1764, 10).

1782.

Schwaiger, Herculanus.

Beschreibung eines Verdunstungsmessers. Bayer. met. ephem., 1782, 2.

1783.

Paterson, J.

De evaporatione complectens. Edinburgh. 1783. 8vo.

Saussure, Horace Bénédicte de.

Essais sur l'Hygrométrie. Neuchâtel. 1783. xxiv+367. 2 pls. 4to.

Essay 3 deals with the theory of evaporation in which it is concluded that: (1) evaporation is the effect of the intimate union of elementary heat with water whereby is formed an elastic fluid, called vapor, rarer than air; (2) this vapor is called pure elastic vapor when formed in a void, or when its abundance and sustained heat give it force to repel the air which presses it; (3) but when this same vapor cannot entirely surmount the compressive force of the air, it penetrates and mingles with it and undergoes a true dissolution, and is then called dissolved elastic vapor; (4) when the saturated air is allowed to precipitate the vapor which it contains, this water sometimes takes the form of vesicles or little bubbles; these vesicles, filled with and enveloped by a rare, light fluid, float and rise because they are specifically lighter than air, and constitute vesicular vapor; (5) when the elastic vapor, or the vesicles themselves, are condensed in full drops, differing from rain drops only by their extreme smallness, they are still very different from vapor, properly speaking; but as they float in the air and can even be sustained for some time by its movement and by its viscosity, they are classed with vapors and called concrete vapor.

The essay closes with a discussion of the theories and experiments of Kratzenstein, Priestley, Nollet, Cullen, Lambert, Richmann, Musschenbroek, Wallerius, Kraft, Gautheron, Haller.

Schwaiger, Herculanus.

Descriptio atmidometri nostri et methodi quam in observando adhibemus. Mannheim ephem. soc. met. palat., 1783, 4:300.

Titius, J. D.

Ueber die Ausdunstung des Eises. Wittenberg. Wochenbl., 1783, 16:309–10.

Discusses the results of Braun and Saussure concerning evaporation of ice, and concludes that evaporation follows the same general law in the case of ice as in that of water, except at the moment of freezing, when the evaporation appears to be greater than it should be.

1784.

Saussure, H. B. de.

Versuch über die Hygrometrie. Uebersetzt aus dem französischen von Johann Daniell Titius. Leipsic. 1784. 8vo.

Translation of his Essais sur l'Hygrometrie of 1783 (q. v.).

[*To be continued.*]

CORRIGENDA.

In the MONTHLY WEATHER REVIEW for May, 1908, Vol. XXXVI, No. 5, page 130, column 2, line 6, for "consonants" read "constants." On page 147, column 1, line 49, the A in both instances should be changed to a. On page 147, line 2 from the bottom, for $PS=a=m\,\omega^2 r\cos^2\varphi$ read $PS=a-m\,\omega^2 r\cos^2\varphi$. On page 148, column 1, line 2, insert "in" between (fig. 2) and "the time $t\ldots$" On page 148, column 1, line 8 from the top, instead of $PQ=vt=r(\varphi'-\varphi)\div\frac{vt}{\varphi'-\varphi}$ read $PQ=vt=r(\varphi'-\varphi)$, $\therefore r=\frac{vt}{\varphi'-\varphi}$.

THE WEATHER OF THE MONTH.

By Mr. P. C. DAY, Acting Chief, Climatological Division.

PRESSURE AND WINDS.

The distribution of mean atmospheric pressure for June, 1908, over the United States and Canada, is graphically shown on Chart VI, and the average values and departures from the normal are shown for each station in Tables I and III.

The high pressure, normal for the season over the Atlantic coast districts, extended much farther west than usual and the pressure was correspondingly higher than the average over all eastern districts of the United States and Canada. Pressure for the month was also slightly above the normal from the lower Missouri Valley westward over the central Mountain and Plateau districts, and considerably above average over the entire Pacific coast.

Barometric pressure was slightly below the normal from central Texas northwestward over New Mexico and Colorado, and it was also below normal along the northern boundary from northern Minnesota westward to eastern Washington, extending northward over the British Northwest Provinces.

The distribution of pressure was such that southerly winds prevailed over all districts except near the south Atlantic coast, where they were from the northeast, and over the Pacific coast States where they were westerly.

Wind movement was above the average from New England westward over the Lake region to the Mississippi Valley and southwestward over the Plains region and Texas to the south Pacific coast. Over portions of the upper Mississippi Valley and Lake region the excess of wind movement above the normal ranged from 25 to 50 per cent. Less than the average wind movement occurred over the east Gulf States and in portions of the northern Rocky Mountain and middle Plateau districts.

TEMPERATURE.

The average temperature for the month was below normal over practically all districts west of the Mississippi River, except over Louisiana, Texas, and small areas in Colorado and New Mexico. Over portions of the central and northern Plateau districts the average deficiency ranged from 4° to 6° per day, and the month was one of the coolest on record. The month was also unusually cool over the whole of California where the departures from the mean temperature ranged from −2° to −5° daily.

Average temperatures and departures from the normal.

Districts.	Number of stations.	Average temperatures for the current month.	Departures for the current month.	Accumulated departures since January 1.	Average departures since January 1.
		°	°	°	°
New England	12	65.1	+ 1.2	+ 2.9	+ 0.5
Middle Atlantic	16	70.3	+ 0.1	+ 6.1	+ 1.0
South Atlantic	10	75.6	− 0.5	+ 8.0	+ 1.3
Florida Peninsula*	8	79.3	− 0.4	+ 7.7	+ 1.3
East Gulf	11	78.5	+ 0.4	+ 8.8	+ 1.5
West Gulf	10	79.5	+ 0.7	+13.7	+ 2.3
Ohio Valley and Tennessee	13	72.9	− 0.4	+ 8.0	+ 1.3
Lower Lake	10	67.3	+ 0.4	+ 2.6	+ 0.4
Upper Lake	12	63.1	+ 0.1	+ 9.4	+ 1.6
North Dakota*	9	61.2	− 1.6	+19.5	+ 3.2
Upper Mississippi Valley	15	68.9	− 2.0	+11.2	+ 1.9
Missouri Valley	12	68.6	− 2.3	+18.3	+ 3.0
Northern Slope	9	58.5	− 3.7	+ 8.7	+ 1.4
Middle Slope	6	70.6	− 1.1	+16.6	+ 2.8
Southern Slope*	7	77.0	+ 0.2	+12.0	+ 2.0
Southern Plateau*	12	73.0	− 2.3	− 0.8	− 0.1
Middle Plateau*	10	59.8	− 4.4	− 3.0	− 0.5
Northern Plateau*	12	59.3	− 2.5	+ 2.7	+ 0.4
North Pacific	7	56.5	− 1.1	− 0.9	− 0.2
Middle Pacific	8	61.5	− 2.7	− 2.2	− 0.4
South Pacific	4	63.7	− 2.4	+ 1.2	+ 0.2

* Regular Weather Bureau and selected cooperative stations.

Over the districts east of the Mississippi River the departures were comparatively small. Over most of New England and the upper Lake region they averaged about 2° above the normal, and they were also slightly above over New York and Pennsylvania and portions of the east Gulf States. Slight deficiencies occurred in the Ohio Valley and Middle Atlantic States.

Maximum temperatures were moderate over all eastern districts, the highest recorded ranging from 90° to 98° over the more southern portions. High temperatures were recorded over the upper Missouri Valley and northern Plateau districts from the 24th to the 26th, and temperatures from 100° to 112° were recorded in the interior valleys of California and Arizona. On the immediate Pacific coast they were generally less than 80°.

The minimum temperatures were generally above 40°, except over the more northern districts, where at scattered points in New England, the upper Lake region, and in the mountains of the West they were below the freezing point. A temperature of 24° was recorded in northern Maine, and unusually cold weather with frost prevailed over portions of the upper Lake region on the 1st and again about the 15th.

Frosts were frequent and did considerable damage in portions of Utah and Nevada during the first half of the month.

PRECIPITATION.

The distribution of precipitation during June, 1908, is graphically shown on Chart IV by appropriate shading or by figures representing the actual amount of fall over districts, the topography of which is too varied to admit of approximately correct shading.

Average precipitation and departures from the normal.

Districts.	Number of stations.	Average.		Departure.	
		Current month.	Percentage of normal.	Current month.	Accumulated since Jan. 1.
		Inches.		*Inches.*	*Inches.*
New England	12	1.58	51	−1.5	−2.5
Middle Atlantic	16	2.69	71	−1.1	−0.8
South Atlantic	10	4.70	96	−0.2	−2.0
Florida Peninsula*	8	7.26	109	+0.6	−3.9
East Gulf	11	2.86	61	−1.7	−0.1
West Gulf	10	2.20	59	−1.5	+1.7
Ohio Valley and Tennessee	13	2.23	53	−2.0	−0.3
Lower Lake	10	2.47	69	−1.1	+1.1
Upper Lake	12	2.32	68	−1.1	−0.8
North Dakota*	9	3.36	94	−0.2	+0.8
Upper Mississippi Valley	15	4.37	103	+0.1	+3.1
Missouri Valley	12	6.70	156	+2.4	+3.3
Northern Slope	9	3.34	149	+1.1	+2.2
Middle Slope	6	7.04	217	+3.8	+3.7
Southern Slope*	7	5.34	155	+1.9	+4.8
Southern Plateau*	12	0.18	47	−0.2	0.0
Middle Plateau*	10	0.71	139	+0.2	−0.7
Northern Plateau*	12	1.83	138	+0.5	−1.4
North Pacific	7	0.98	47	−1.1	−2.6
Middle Pacific	8	0.08	21	−0.3	−3.9
South Pacific	4	0.00	00	−0.1	−1.3

* Regular Weather Bureau and selected cooperative stations.

The rainfall during June was generally abundant in amount and well distributed during the various periods of the month over all districts from the Rocky Mountains eastward to the Atlantic, except portions of New England, the Middle Atlantic States, the Lake region, and over small areas in Alabama and portions of southern and western Texas.

Over the Great Plains districts from southern Minnesota and South Dakota southward to northern Texas, the monthly amounts ranged from 4 to more than 10 inches, and amounts from 4 to 6 inches were general over most of the Gulf States.

Heavy rains in the lower Missouri Valley caused high waters in that river and its tributaries in western Missouri and surrounding districts, and the heavy rains in southern Montana during the first few days of the month, in conjunction with the heavy snows and rains of the latter part of May, caused some disastrous floods over the southern part of that State.

Precipitation was comparatively light, less than 1 inch, along the New England coast from Massachusetts to Maine, over portions of the lower Michigan Peninsula, in central Alabama, and generally west of the Main Divide of the Rocky Mountains.

No rain occurred over southern California, southwestern Arizona, and portions of southern Texas.

Precipitation was above the normal from the northern Rocky Mountain districts easterly and southeasterly to the Mississippi Valley and at scattered points in the South Atlantic and east Gulf States. Over portions of the Great Plains the excess ranged from 4 to 10 inches.

There was a general deficiency of precipitation over most of Texas and the States east of the Mississippi River, except as noted above, and also over the Pacific coast States, Arizona, New Mexico, and portions of southern Colorado and Utah. Over New England the drought was becoming severe, and rain was needed in portions of the Middle Atlantic States.

Severe storms, with hail and high winds, and possessing in some cases the characteristics of tornadoes, prevailed with unusual frequency in portions of Nebraska, South Dakota, and Wisconsin, causing considerable damage.

HUMIDITY AND SUNSHINE.

The average relative humidity was above the normal over practically all districts west of the Mississippi, the only exceptions being portions of western Texas, New Mexico, and Colorado, and the central portions of California, Oregon, and Washington. Over the upper Missouri Valley and northern Rocky Mountain and Plateau districts the excess ranged from 10 to 15 per cent. East of the Mississippi River there was a general deficiency, amounting to 8 to 12 per cent, over portions of New England and the Middle Atlantic States.

Much cloudy weather prevailed over the upper Mississippi and middle Missouri valleys where the amount of clear sky was generally less than 50 per cent of the possible. Cloudy weather was rather general in the Appalachian Mountain region, in southern Florida, and near the coast of Washington.

Along the middle Atlantic coast and over much of New England the amount of sunshine was generally high, ranging from 60 to 70 per cent of the possible. Abundant sunshine was the rule over most of the districts west of the Rocky Mountains, and in portions of the interior valleys of southwestern Arizona and central California the sunshine was almost continuous. At Yuma, Ariz., the absence of clouds was phenomenal; sunshine was practically uninterrupted, the amount being 99 per cent of the possible, and only on a few days were there even the slightest traces of clouds.

WEATHER IN ALASKA.

Over the southern coast districts the rainy season ended the last of May, and but little precipitation occurred during the current month, the monthly falls ranging from 0.11 inch at Skagway to 2.45 inches at Juneau. Considerable clear weather prevailed, and temperatures ranged generally between 40° and 60° with extremes of 84° and 33°.

Over the Cook Inlet and Kenai Peninsula districts the rainy season continued during the first week in June, after which much clear weather appears to have prevailed, with temperatures ranging from 40° to 60° and extremes of 70° and 37°.

In the upper Yukon district light showers were comparatively frequent, and thunderstorms accompanied by hail and high winds were reported. The temperatures ranged generally from about 40° at night to 70° and 80° during the day with extremes of 89° and 31°.

In Canada.—Director R. F. Stupart says:

The mean temperature for June differed little from normal in any part of Canada. From the Lower Mainland of British Columbia, however, to New Ontario, and also over the northern portion of the Gulf of St. Lawrence, values were slightly subnormal, whilst elsewhere in Canada a mean temperature in excess of the average was recorded. In the Western Provinces negative departures from average amounted to from 1° to 2°, while in Ontario, Quebec, and the Maritime Provinces positive departures were from 1° to 4°.

The chief feature of the distribution of precipitation during June was the excessive amount over the central and northern portions of Alberta and Saskatchewan, where the fall was almost generally more than twice the average amount, while with local exceptions the amount of rain recorded elsewhere in Canada was much less than normal.

Average cloudiness and departures from the normal.

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
New England	3.6	− 1.5	Missouri Valley	5.5	+ 0.7
Middle Atlantic	4.2	− 0.8	Northern Slope	4.7	− 0.1
South Atlantic	4.5	− 0.4	Middle Slope	4.5	+ 0.8
Florida Peninsula	5.9	+ 0.4	Southern Slope	3.4	− 1.0
East Gulf	4.5	− 0.3	Southern Plateau	1.3	− 0.6
West Gulf	4.2	− 0.4	Middle Plateau	3.4	+ 0.4
Ohio Valley and Tennessee	4.8	− 0.2	Northern Plateau	4.4	− 0.7
Lower Lake	3.5	− 1.4	North Pacific	6.0	− 0.1
Upper Lake	4.7	− 0.5	Middle Pacific	2.9	− 0.3
North Dakota	5.6	+ 0.4	South Pacific	2.2	− 1.1
Upper Mississippi Valley	5.1	+ 0.1			

Average relative humidity and departures from the normal.

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
	%			%	
New England	73	− 6	Missouri Valley	73	+ 6
Middle Atlantic	70	− 3	Northern Slope	66	+ 9
South Atlantic	79	+ 1	Middle Slope	63	+ 3
Florida Peninsula	80	0	Southern Slope	57	− 3
East Gulf	73	− 2	Southern Plateau	27	− 3
West Gulf	76	0	Middle Plateau	40	+12
Ohio Valley and Tennessee	67	− 3	Northern Plateau	58	+ 2
Lower Lake	69	− 2	North Pacific	77	+ 2
Upper Lake	71	− 2	Middle Pacific	63	+ 1
North Dakota	71	+ 3	South Pacific	65	− 1
Upper Mississippi Valley	71	+ 1			

Maximum wind velocities.

Stations.	Date.	Velocity.	Direction.	Stations.	Date.	Velocity.	Direction.
Amarillo, Tex.	28	58	nw.	Oklahoma, Okla.	9	60	n.
Buffalo, N. Y.	19	72	nw.	Do	13	61	n.
Canton, N. Y.	19	51	sw.	Point Reyes Light, Cal.	1	76	nw.
Cleveland, Ohio	19	52	sw.	Do	2	70	nw.
Columbus, Ohio	19	59	nw.	Do	3	72	nw.
Detroit, Mich.	19	52	w.	Do	4	50	nw.
Do	23	50	w.	Do	15	60	nw.
Green Bay, Mich.	22	59	w.	Do	16	65	nw.
Jacksonville, Fla.	15	68	sw.	Do	17	60	nw.
Kansas City, Mo.	28	57	n.	Do	18	72	nw.
Lincoln, Nebr.	22	63	sw.	Do	19	73	nw.
Modena, Utah	2	68	sw.	Do	21	56	nw.
Mount Tamalpais, Cal.	1	68	nw.	Do	24	60	nw.
Do	2	77	nw.	Do	25	72	nw.
Do	15	58	nw.	Do	26	72	nw.
Do	16	72	nw.	Port Huron, Mich.	8	60	w.
Do	17	71	nw.	St. Paul, Minn.	22	54	sw.
Do	18	64	nw.	Southeast Farallon, Cal.	1	52	nw.
Do	19	58	nw.	Do	2	50	nw.
Do	20	50	sw.	Sioux City, Iowa	22	60	sw.
Do	21	50	nw.	Syracuse, N. Y.	19	50	w.
Do	25	60	nw.	Toledo, Ohio	13	52	s.
Do	26	58	nw.				

CLIMATOLOGICAL SUMMARY.

By Mr. P. C. DAY, Acting Chief, Climatological Division.

TEMPERATURE AND PRECIPITATION BY SECTIONS, JUNE, 1908.

In the following table are given, for the various sections of the Climatological Service of the Weather Bureau, the average temperature and rainfall, the stations reporting the highest and lowest temperatures with dates of occurrence, the stations reporting greatest and least monthly precipitation, and other data, as indicated by the several headings.

The mean temperatures for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperature and precipitation are based only on records from stations that have ten or more years of observation. Of course the number of such records is smaller than the total number of stations.

Section.	Temperature—in degrees Fahrenheit.							Precipitation—in inches and hundredths.					
	Section average.	Departure from the normal.	Monthly extremes.					Section average.	Departure from the normal.	Greatest monthly.		Least monthly.	
			Station.	Highest.	Date.	Station.	Lowest.	Date.			Station.	Amount.	Station.	Amount.
Alabama	77.5	— 0.5	Selma	102	21	Scottsboro	49	17	2.75	— 1.34	Pushmataha	7.57	Letohatchee	0.15
Arizona	75.4	— 2.5	Maricopa	126	9	Williams	22	1	0.06	— 0.14	Flagstaff	0.69	28 stations	0.00
Arkansas	76.0	— 0.4	5 stations	98	22, 23	Pond	46	14	3.85	— 0.26	Centerpoint	8.83	Lake Farm	0.61
California	66.0	— 3.3	Heber	117	30	Tamarack	16	3	0.17	— 0.18	Monumental	2.46	Many stations	0.00
Colorado	59.1	— 2.0	Lamar Las Animas	104 104	21 27	Wagon Wheel Gap	15	5,20	0.96	— 0.28	Holyoke	4.33	2 station	0.00
Florida	79.3	— 0.6	3 stations	100	3 d't's	Orange City	56	9	5.98	— 1.04	Miami	13.75	Madison	1.52
Georgia	77.5	— 0.5	Helena	103	20	Dahlonega	50	17	3.40	— 1.14	St. George	8.44	Canton	0.70
Hawaii														
Idaho	55.9	— 3.2	Lewiston Orofino	101 101	24 24	Forney Roosevelt	23 23	28 20	2.60	+ 1.14	Camp Steeley	5.05	Lewiston	0.65
Illinois	70.5	— 1.0	Benton	100	22	Yorkville	36	16	2.86	— 1.14	Coatsburg	5.90	McLeansboro	0.65
Indiana	70.8	— 0.9	Vincennes	101	23	Salamonia	35	16	2.01	— 2.06	Farmland	5.77	Evansville	0.66
Iowa	67.1	— 1.7	Clinton Decorah	94 94	22 23	Elma	35	15	5.66	+ 1.14	Plover	11.88	Sigourney	1.77
Kansas	72.1	— 1.1	Coolidge	110	21	Hoxie Saint Francis	42 42	1 29	8.27	+ 3.86	Frankfort	15.00	Wallace	1.55
Kentucky	73.4	— 0.6	3 stations	102	23	Farmers Maysville	43 43	16 16	4.36	— 0.66	Bowling Green	7.21	Eubank	1.25
Louisiana	80.6	+ 0.9	Melville Opelousas	101 101	24 24	Robeline	57	27	4.10	— 1.13	Grand Coteau	9.91	Robeline	0.75
Maryland and Delaware	70.4	— 0.1	College Park, Md.	99	23	Deer Park, Md.	39	2,3	2.12	— 2.03	Solomons, Md.	4.00	Coleman	1.06
Michigan	64.7	+ 1.0	Pontiac	98	19	Chatham	25	11	2.07	— 1.22	Ironwood	5.11	Omer	0.30
Minnesota	62.5	— 2.1	New Ulm	92	6, 26	Stevens Mine	28	15	6.34	+ 2.31	St. Peter	12.10	Crookston	1.42
Mississippi	78.4	— 0.3	Duck Hill	101	23	Pittsboro Water Valley	54 54	4 4,5	4.89	+ 0.44	Merrill	8.94	Shoccoe	1.37
Missouri	72.3	— 1.1	Caruthersville	98	22	Mexico	43	11	6.30	+ 1.78	Warrensburg	13.29	Hollister	2.05
Montana	56.4	— 2.2	Glendive	100	26	Lubec	20	1	3.51	+ 1.14	Evans	11.84	Jordan	0.70
Nebraska	66.6	— 2.1	Lynch	102	21	Kimball Fort Robinson	35 35	22 28	6.74	+ 2.64	Ellis	17.75	Gering	1.85
Nevada														
New England*	65.7	+ 1.5	Millinocket, Me	96	9	Van Buren, Me	24	5	1.75	— 1.68	St. Johnsburg, Vt.	4.78	Concord, N. H	0.29
New Jersey	69.9	+ 0.7	Browns Mills Elizabeth	99 99	23, 24 24	Layton	35	3	2.32	— 1.35	Imlaystown	4.63	Woodbine	0.77
New Mexico	68.8	— 2.0	Orange	110	21	Elizabethtown	22	5	0.44	— 0.62	Mineral Hill	3.19	6 stations	0.00
New York	65.9	+ 1.2	Waverly	98	22	Paul Smiths	23	3	2.70	— 0.98	Hunt	6.65	Scarsdale	0.55
North Carolina	73.1	— 1.1	Rockingham	104	22	Banners Elk	37	16	4.82	— 0.09	Newbern	9.95	Asheville	0.91
North Dakota	60.4	— 1.2	Medora	93	26	3 stations	27	3 d't's	3.37	— 0.38	Bottineau	7.15	Farman	1.30
Ohio	69.2	— 0.1	Camp Dennison	100	23	3 stations	33	16	2.52	— 1.32	Greenville	5.30	Philo	1.00
Oklahoma	75.2	— 1.0	Hooker	108	21	Hurley	40	10	8.85	+ 5.24	Shawnee	17.56	Kenton	T.
Oregon	59.3	+ 0.2	Blalock	103	30	Christmas Lake	21	2	1.38	— 0.22	Orseco	7.70	Hermiston	T.
Pennsylvania	68.8	+ 0.9	Hanover	102	24	Pocono Lake	28	3	2.36	— 1.63	Derry station	4.31	Renovo	0.58
Porto Rico	78.1		Arecibo	99	5	Aibonito	54	1	5.43		Coloso	12.67	Barros	1.17
South Carolina	76.6	— 1.1	Florence Heath Springs	100 100	20 20	Liberty	48	8	4.90	— 0.34	Walterboro	9.10	Smiths Mills	1.08
South Dakota	68.7	— 2.1	Greenwood Oelrichs	100 100	21 25	Castlewood	30	10	5.32	+ 1.59	Fairfax	10.59	Manderson	1.82
Tennessee	74.4	— 0.3	Lewisburg	101	23	Erasmus	38	16	4.50	— 0.12	2 stations	8.70	Chattanooga	0.89
Texas	81.1	+ 1.2	Fort McIntosh	115	17	Dalhart	42	2,5	2.48	— 1.20	Paris	8.50	4 stations	0.00
Utah	59.6	— 5.7	St. George	104	25	Tropic	20	4	1.09	+ 0.97	Farmington	3.47	4 stations	0.00
Virginia	70.2	— 1.5	Quantico	99	24	Hot Springs	39	2	4.44	+ 0.13	2 stations	6.81	Elk Knob	2.58
Washington														
West Virginia	69.2	— 0.8	3 stations	98	23, 24	Terra Alta	36	2	3.12	— 1.38	Princeton	6.75	Moorfield	1.35
Wisconsin	63.8	— 1.5	Whitehall	100	22	Long Lake	25	1, 15	4.10	+ 0.03	Downing	9.32	Sheboygan	1.42
Wyoming	54.4	— 3.7	Basin	96	25	3 stations	19	2, 28	2.74	+ 1.12	Kirtley	6.11	2 stations	0.57

*Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut.

DESCRIPTION OF TABLES AND CHARTS.

By Mr. P. C. DAY, Acting Chief, Climatological Division.

For description of tables and charts see page 8 of REVIEW for January, 1908.

TABLE I.—*Climatological data for U. S. Weather Bureau stations, June, 1908.*

Stations.	Elevation of instruments.			Pressure, in inches.			Temperature of the air, in degrees Fahrenheit.										Mean wet thermometer.	Mean temperature of the dew-point.	Mean relative humidity, per cent.	Precipitation, in inches.			Wind.					Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness during daylight, tenths.	Total snowfall.
	Barometer above sea level, feet.	Thermometers above ground.	Anemometer above ground.	Actual, reduced to mean of 24 hours.	Sea level, reduced to mean of 24 hrs.	Departure from normal.	Mean max. + mean min. ÷ 2.	Departure from normal.	Maximum.	Date.	Mean maximum.	Minimum.	Date.	Mean minimum.	Greatest daily range.					Total.	Departure from normal.	Days with .01, or more.	Total movement, miles.	Prevailing direction.	Maximum velocity. Miles per hour.	Maximum velocity. Direction.	Maximum velocity. Date.					
New England.							**65.1**	**+ 1.2**											**73**	**1.58**	**— 1.5**									**3.6**	
Eastport	76	69	85	29.88	29.96	+ .03	57.0	+ 2.6	83	20	66	37	2	48	34	52	49	78	1.01	— 2.2	5	6,522	s.	31	w.	17	7	19	4	5.2	
Greenville	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Portland, Me.	103	81	117	29.88	30.00	+ .05	64.6	+ 2.0	89	20	74	42	2	55	27	57	52	66	0.53	— 2.8	3	6,761	s.	30	s.	15	19	8	3	3.2	
Concord	288	70	79	29.70	30.00	+ .04	66.0	+ 1.6	90	8	80	36	3	52	40	.....	.....	.....	0.29	— 3.0	3	3,642	nw.	22	nw.	16	25	5	0	1.5	
Burlington	404	12	47	29.58	30.01	+ .05	64.2	— 2.6	89	8	75	34	3	54	32	.....	.....	.....	2.46	— 0.8	12	7,350	s.	36	s.	19	16	12	2	4.1	
Northfield	876	16	70	29.09	30.03	+ .07	60.4	— 2.3	88	8	74	31	3	46	39	60	58	83	2.68	— 0.4	11	5,301	s.	31	nw.	2	12	16	2	4.3	
Boston	125	115	188	29.89	30.02	+ .06	69.8	+ 4.0	90	8	80	49	2	60	33	61	55	63	1.08	— 2.0	7	7,037	sw.	31	nw.	2	15	11	4	4.1	
Nantucket	12	14	90	30.02	30.03	+ .05	63.2	+ 1.9	78	25	70	44	7	56	24	60	58	84	1.66	— 0.8	5	10,232	sw.	32	sw.	9	16	12	2	4.2	
Block Island	26	11	46	30.02	30.05	+ .08	64.0	+ 2.4	80	20	70	49	2	58	19	60	58	83	2.02	— 0.8	6	9,669	sw.	40	nw.	24	19	10	1	2.9	
Narragansett	.....	9	.....	.....	.....	.....	64.8	+ 0.6	84	20	73	40	3	57	24	.....	.....	.....	3.95	.....	6	.....	sw.	.....	.....	.....	26	4	0	.....	
Providence	160	57	67	29.87	30.04	+ .07	68.2	— 0.1	91	20	79	46	6	57	32	60	55	67	2.01	— 1.0	6	4,213	sw.	20	nw.	21	17	10	3	3.3	
Hartford	159	122	132	29.87	30.04	+ .07	69.6	+ 2.5	90	24	81	45	3	58	32	62	58	69	2.42	— 0.7	6	4,987	s.	27	s.	15	12	14	4	4.4	
New Haven	106	116	155	29.93	30.04	+ .07	69.2	+ 2.3	91	21	79	47	3	59	30	61	56	65	1.20	— 2.0	4	6,085	s.	32	w.	24	18	11	1	2.9	
Mid. Atlantic States.							**70.3**	**+ 0.1**											**70**	**2.69**	**— 1.1**									**4.2**	
Albany	97	102	115	29.92	30.02	+ .05	69.4	+ 1.5	89	20	80	43	3	58	33	61	55	61	2.32	— 1.4	9	5,070	s.	24	sw.	14	20	8	2	3.1	
Binghamton	871	78	90	29.14	30.06	+ .09	66.2	0.0	92	24	78	39	3	54	35	.....	.....	.....	1.11	— 2.5	5	3,636	nw.	24	w.	9	11	11	8	5.1	
New York	314	108	350	29.71	30.04	+ .06	71.6	+ 3.5	93	24	80	56	7	63	25	62	57	64	1.70	— 1.6	6	6,852	s.	42	w.	24	13	15	2	3.7	
Harrisburg	374	94	104	29.67	30.06	+ .07	71.8	+ 1.5	96	24	82	50	17	62	28	63	58	65	1.05	— 2.5	4	4,120	sw.	36	nw.	24	14	14	2	4.3	
Philadelphia	117	116	184	29.94	30.06	+ .08	73.1	+ 1.9	95	24	82	57	6	64	25	63	57	61	2.41	— 0.9	5	6,583	s.	26	n.	15	13	14	3	4.2	
Scranton	805	111	119	29.21	30.05	+ .07	68.5	+ 1.3	94	24	80	42	3	56	33	60	55	62	1.71	— 1.9	6	4,374	sw.	36	nw.	24	15	13	2	3.5	
Atlantic City	52	37	48	30.02	30.07	+ .09	68.2	+ 1.4	90	20	74	51	7	62	27	63	59	74	1.04	— 2.0	4	5,412	sw.	18	s.	19	11	11	8	4.7	
Cape May	17	48	52	30.07	30.09	+ .11	68.2	+ 0.5	87	20	74	52	7	62	21	64	.....	.....	1.29	— 1.8	4	5,297	s.	24	nw.	16	16	10	4	3.4	
Baltimore	123	100	113	29.94	30.06	+ .07	73.6	+ 0.6	98	24	83	55	2	65	26	65	60	64	1.08	— 2.8	5	4,830	sw.	27	nw.	15	8	10	12	5.8	
Washington	112	59	76	29.95	30.06	+ .06	71.8	— 0.9	97	24	82	52	17	62	29	65	61	70	1.73	— 2.4	8	4,281	nw.	32	nw.	24	15	12	3	3.9	
Cape Henry	18	9	58	30.05	30.07	+ .07	72.2	— 0.7	93	24	79	60	17	65	22	.....	.....	.....	3.02	— 1.4	6	8,567	ne.	38	ne.	11	21	5	4	2.8	
Lynchburg	681	83	88	29.35	30.08	+ .07	71.6	— 1.9	94	23	82	52	3	62	30	66	64	80	4.66	+ 0.8	11	2,297	ne.	24	n.	24	12	11	7	5.2	
Mount Weather	1,725	10	54	28.28	30.06	+ .06	66.6	— 1.0	87	24	74	47	16	59	22	61	58	78	3.86	— 0.9	11	7,228	nw.	41	nw.	16	8	13	9	5.4	
Norfolk	91	102	111	29.98	30.07	+ .07	72.8	— 1.6	94	20	81	60	3	65	24	67	64	76	4.56	+ 0.2	6	5,740	ne.	25	nw.	21	18	7	5	3.7	
Richmond	144	145	153	29.99	30.07	+ .06	72.9	— 2.2	94	20	83	56	16	63	28	.....	.....	.....	5.72	+ 2.2	9	4,779	se.	32	nw.	21	16	8	6	4.0	
Wytheville	2,293	40	47	27.75	30.07	+ .06	67.0	— 1.7	88	23	78	46	16	57	31	63	61	86	5.74	+ 1.6	11	2,445	w.	18	nw.	22	12	13	5	4.3	
S. Atlantic States.							**75.6**	**— 0.5**											**79**	**4.70**	**— 0.2**									**4.5**	
Asheville	2,255	53	75	27.77	30.06	+ .05	69.1	+ 0.4	88	20	79	48	16	59	29	64	62	81	0.91	— 3.4	10	4,743	se.	29	e.	5	9	16	5	4.9	
Charlotte	773	68	76	29.25	30.07	+ .06	74.4	— 1.1	94	20	84	58	16	65	27	66	62	72	2.65	— 1.8	9	2,965	ne.	24	w.	10	8	15	7	5.4	
Hatteras	11	12	47	30.05	30.06	+ .05	73.8	— 0.6	87	1	79	62	3	69	17	70	69	85	6.22	+ 1.9	10	8,904	ne.	40	n.	15	21	5	4	3.0	
Manteo	.....	.....	.....	.....	.....	.....	72.1	.....	89	20	79	52	3	65	.....	.....	.....	.....	7.54	+ 3.2	8	.....	ne.	.....	.....	0	22	5	3	.....	
Raleigh	376	71	79	29.68	30.06	+ .05	74.3	— 0.8	96	20	85	57	8	64	31	66	63	72	6.20	+ 1.5	11	3,919	ne.	34	nw.	20	15	8	7	4.5	
Wilmington	78	81	91	29.98	30.06	+ .05	75.1	— 0.4	93	21	83	60	28	67	25	69	67	80	5.39	— 0.2	12	5,174	ne.	28	w.	22	11	14	5	4.5	
Charleston	48	14	92	29.99	30.04	+ .03	78.3	— 0.2	92	1	84	69	7	72	21	73	71	83	2.70	— 2.7	10	7,124	ne.	39	ne.	22	8	19	3	4.7	
Columbia, S. C.	351	41	57	29.68	30.05	+ .04	76.6	— 1.6	96	20	87	61	16	67	27	68	65	73	4.21	0.0	13	4,069	ne.	30	w.	10	8	13	9	5.5	
Augusta	180	89	97	29.85	30.04	+ .03	77.6	— 0.5	93	20	87	63	8	68	27	71	69	79	6.91	+ 2.4	11	3,798	ne.	32	nw.	4	19	8	3	3.0	
Savannah	65	81	89	29.97	30.04	+ .03	78.6	+ 0.4	92	1	86	67	9	71	23	72	69	80	4.59	— 1.4	9	4,593	e.	30	w.	10	8	19	3	4.9	
Jacksonville	43	101	129	29.99	30.04	+ .03	78.4	— 0.6	93	1	86	65	29	71	23	73	71	82	4.35	— 1.2	11	5,903	ne.	68	sw.	15	12	13	5	4.9	
Florida Peninsula.							**79.2**	**— 0.9**											**80**	**7.81**	**+ 1.8**									**5.9**	
Jupiter	28	10	48	29.99	30.02	+ .01	78.2	— 1.4	90	11	85	69	9	72	19	74	73	83	9.75	+ 2.8	21	5,859	se.	36	w.	26	0	19	11	6.5	
Key West	22	10	53	29.99	30.01	+ .02	80.2	— 2.0	88	12	86	70	1	75	17	75	73	78	11.43	+ 7.2	16	4,603	se.	28	w.	6	7	15	8	6.0	
Sand Key	25	41	71	29.97	30.00	+ .01	81.2	.....	92	28	86	68	17	77	20	.....	.....	.....	3.88	— 0.4	14	6,624	e.	44	s.	17	4	17	9	6.1	
Tampa	35	79	96	29.99	30.02	+ .01	79.3	+ 0.6	93	20	88	67	1	70	23	72	70	78	6.18	— 2.2	15	4,671	ne.	34	ne.	7	10	13	7	5.1	
East Gulf States.							**78.5**	**+ 0.4**											**73**	**2.86**	**— 1.7**									**4.5**	
Atlanta	1,174	190	216	28.84	30.05	+ .04	75.3	— 0.3	92	20	85	58	16	66	27	67	63	70	3.04	— 0.8	9	6,534	se.	36	nw.	4	18	5	7	4.4	
Macon	370	58	66	29.65	30.04	+ .03	78.8	+ 1.7	96	21	90	63	16	68	29	.....	.....	.....	2.55	— 1.0	8	2,878	e.	27	w.	10	16	11	3	3.6	
Thomasville	273	8	58	29.76	30.03	+ .03	79.2	— 0.3	95	23	91	60	29	68	31	71	68	74	3.00	— 1.7	11	3,202	e.	23	e.	5	15	14	1	3.2	
Pensacola	56	79	96	29.96	30.02	+ .03	79.1	— 0.9	89	30	86	66	10	72	19	.....	.....	.....	4.38	— 0.5	10	6,038	s.	40	nw.	10	11	13	6	4.6	
Anniston	741	9	58	29.28	30.06	+ .06	76.5	+ 1.5	97	23	88	56	16	65	31	.....	.....	.....	1.88	— 2.0	8	3,484	se.	29	nw.	3	8	15	7	5.3	
Birmingham	700	11	48	29.29	30.05	+ .06	77.4	— 0.8	95	22	87	58	16	68	26	69	65	71	1.24	— 2.6	7	3,809	se.	32	nw.	3	3	22	5	5.9	
Mobile	57	98	106	29.96	30.02	+ .03	79.7	+ 0.6	91	21	88	65	14	72	21	73	70	77	2.28	— 3.7	11	4,603	n.	30	e.	22	13	15	2	4.5	
Montgomery	223	100	112	29.79	30.03	+ .03	79.6	+ 0.5	95	21	90	62	16	69	27	69	64	65	0.45	— 3.8	8	4,142	n.	30	nw.	4	11	13	6	5.0	
Meridian	375	84	93	29.63	30.01	+ .03	77.6	+ 0.3	94	22	88	62	26	68	26	71	68	76	6.58	+ 2.0	11	3,210	se.	33	sw.	14	14	14	2	3.9	
Vicksburg	247	62	74	29.74	30.02	+ .05	78.7	+ 0.2	93	24	88	64	13	70	23	72	69	75	3.71	— 0.8	11	4,128	se.	46	nw.	13	18	10	2	3.3	
New Orleans	51	88	121	29.95	30.00	+ .02	81.2	+ 1.6	92	24	88	65	14	74	19	73	71	76	2.39	— 3.8	11	5,127	se.	36	nw.	9	2	21	7	6.0	
West Gulf States.							**79.5**	**+ 0.7**											**76**	**2.20**	**— 1.5**									**4.2**	
Shreveport	249	77	84	29.72	29.98	+ .02	80.2	+ 0.6	94	24	89	65	9	72	25	72	68	73	1.61	— 2.0	8	5,097	se.	39	n.	9	16	12	2	3.8	
Bentonville	1,303	11	44	28.61	29.95	+ .01	72.8	— 1.3	90	23	82	51	14	63	28	.....	.....	.....	3.69	— 0.9	11	2,379	s.	21	s.	18	12	14	4	4.1	
Fort Smith	457	79	94	29.48	29.94	.00	76.2	— 0.6	91	23	85	61	15	67	25	70	66	73	6.56	+ 2.6	11	5,353	e.	46	nw.	3	10	17	3	4.4	
Little Rock	357	139	147	29.62	29.99	+ .03	77.1	— 0.1	92	23	85	62	15	69	22	70	67	73	2.30	— 1.8	7	5,669	s.	46	nw.	9	13	12	5	4.3	
Corpus Christi	20	48	53	29.90	29.92	+ .01	82.0	+ 1.4	89	14	86	74	27	78	12	76	74	81	0.54	— 2.2	3	10,119	se.	33	se.	20	16	12	2	3.4	
Fort Worth	670	106	114	29.22	29.92	.00	80.2	+ 0.1	98	13	89	62	11	71	24	.....	.....	.....	2.90	— 0.1	8	9,320	s.	42	n.	11	9	20	1	4.2	
Galveston	54	106	112	29.92	29.98	+ .03	82.2	+ 1.3	89	25	86	71	11	79	15	76	74	79	0.54	— 4.2	5	8,822	se.	38	nw.	11	15	12	3	4.2	
Palestine	510	73	79	29.41	29.83	— .01	79.8	+ 1.4	94	24	88	63	11	72	24	73	71	79	2.22	— 1.8	8	3,113	se.	12	se.	18	3	19	8	6.2	
San Antonio	701	80	91	29.18	29.89	— .01	82.6	+ 2.2	97	13	92	69	26	73	25	73	69	72	0.30	— 2.8	4	5,274	se.	26	ne.	24	16	13	1	3.8	
Taylor	583	55	63	29.32	29.92	.00	82.0	+ 2.0	94	18	91	69	26	73	23	.....	.....	.....	1.30	— 2.2	4	7,421	s.	32	s.	21	15	12	3	4.0	
Ohio Val. and Tenn.							**72.9**	**— 0.4**											**67**	**2.23**	**— 2.0**									**4.8**	
Chattanooga	762	106	112	29.27	30.06	+ .06	76.1	+ 0.7	95	23	86	58	16	66	27	67	62	66	0.89	— 3.4	7	4,111	s.	28	nw.	3	4	19	7	5.3	
Knoxville	1,004	93	100	29.02	30.05	+ .05	74.2	+ 0.8	95	23	84	54	16	65	26	66	62	69	2.07	— 2.1	8	3,136	ne.	24	s.	13	8	13	9	5.7	
Memphis	399	76	97	29.62	30.03	+ .06	77.2	— 0.5	93	22	85	61	16	70	20	70	68	75	5.73	+ 1.4	7	5,164	s.	46	w.	29	13	9	8	4.7	
Nashville	546	79	91	29.48	30.06	+ .07	75.7	— 0.6	97	23	85	57	16	67	28	68	64	70	2.73	— 1.6	11	3,621	ne.	32	sw.	3	11	10	9	4.9	
Lexington	989	75	102	29.02	30.07	+ .07	71.8	— 1.4	94	23	81	49	1	62	27	.....	.....	.....	2.12	— 1.9	7	5,997	s.	38	nw.	8	15	9	6	4.2	
Louisville	525	111	132	29.48	30.06	+ .08	75.2	+ 0.2	98	23	85	51	1	65	28	65	60	64	3.27	— 1.0	6	5,204	sw.	37	w.	8	10	14	6	4.7	
Evansville	431	72	82	29.56	30.02	+ .05	74.8	— 0.5	97	23	84	52	1	65	26	.....	.....	.....	0.66	— 3.5	8	5,297	s.	29	w.	8	6	24	0	4.6	
Indianapolis	822	154	164	29.17	30.04	+ .07	70.7	— 1.7	94	23	80	46	11	61	28	62	57	64	1.05	— 3.3	8	7,048	sw.	39	w.	23	6	15	9	6.2	
Cincinnati	628	152	160	29.38	30.05	+ .06	72.8	— 0.9	97	23	83	50	1	63	28	63	58	60	2.00	— 2.0	8	4,554	se.	34	nw.	21	9	15	6	4.9	
Columbus	824	173	224	29.19	30.06	+ .07	70.6	— 0.4	94	23	82	47	1	60	30	62	57	64	2.13	— 1.4	10	7,552	se.	59	nw.	19	13	14	3	3.8	
Pittsburg	842	336	352	29.17	30.06	+ .07	70.4	— 0.7	91	23	80	45	16	60	28	62	57	64	1.14	— 2.8	9	5,804	sw.	43	nw.	19	13	13	4	4.1	
Parkersburg	638	77	84	29.42	30.08	+ .08	71.0	— 0.5	93	23	82	47	16	60	33	64	60	71	2.41	— 2.2	11	3,516	s.	30	n.	19	17	8	5	3.7	
Elkins	1,940	41	80	28.08	30.08	+ .08	66.8	— 0.2	88	23	79	45	2	55	35	61	59	80	2.77	— 2.3	13	1,815	s.	24	w.	29	12	10	8	5.1	
Lower Lake Region.							**67.3**	**+ 0.4**											**69**	**2.47**	**— 1.1**									**3.5**	
Buffalo	767	178	206	29.23	30.05	+ .08	66.3	+ 1.2	86	13	74	47	16	58	26	60	56	68	2.45	— 0.7	8	8,468	sw.	72	nw.	19	15	13	2	3.6	
Canton	448	10	71	29.55	30.02	.....	64.4	— 1.4	87	19	75	37	3	53	39	.....	.....	.....	1.72	— 1.7	10	7,621	sw.	51	sw.	19	19	7	4	3.9	
Oswego	338	76	91	29.66	30.03	+ .06	64.6	+ 0.8	91	19	74	44	3	56	33	59	54	70	3.64	+ 0.2	9	5,553	s.	31	sw.	14	20	7	3	3.3	
Rochester	523	81	102	29.49	30.05	+ .08	68.0	+ 1.9	91	19	78	46	3	58	30	60	55	65	3.64	+ 0.5	9	5,322	sw.	34	w.	14	15	10	5	3.9	
Syracuse	397	97	113	29.41	30.05	+ .08	66.6	— 0.3	89	19	76	44	3	57	30	.....	.....	.....	2.78	— 1.1	8	6,828	s.	59	w.	19	16	9	5	3.9	
Erie	713	92	102	29.29	30.04	+ .06	67.5	+ 0.5	90	19	76	50	16	59	25	61	56	65	2.70	— 1.0	8	6,444	s.	41	nw.	22	14	14	2	3.3	
Cleveland	762	190	201	29.24	30.06	+ .08	68.6	+ 0.7	92	23	77	50	2	60	26	62	58	68	2.06	— 1.6	8	9,653	se.	52	sw.	19	17	11	2	3.3	
Sandusky	629	62	70	29.37	30.05	+ .07	69.6	+ 0.8	94	23	78	51	2	61	27	.....	.....	.....	1.72	— 2.1	11	5,633	sw.	27	n.	29	18	7	5	3.3	
Toledo	628	207	246	29.37	30.05	+ .08	69.2	— 0.2	92	23	79	49	16	60	28	61	56	65	2.11	— 1.3	5	9,615	sw.	52	s.	13	21	8	1	2.7	
Detroit	730	218	258	29.27	30.05	+ .08	68.2	+ 0.4	90	23	78	44	16	58	25	64	62	82	1.85	— 2.0	8	8,966	s.	52	w.	19	13	8	9	4.7	
Upper Lake Region.							**63.1**	**+ 1.0**											**71**	**2.32**	**— 1.1**									**4.7**	
Alpena	609	13	92	29.35	30.02	+ .06	61.8	+ 1.5	90	19	72	39	12	51	36	56	52	72	2.79	— 0.8	10	7,191	se.	36	w.	8	13	11	6	4.6	

TABLE I.—*Climatological data for U. S. Weather Bureau stations, June, 1908*—Continued.

Stations.	Elevation of instruments.			Pressure, in inches.			Temperature of the air, in degrees Fahrenheit.									Mean wet thermometer.	Mean temperature of the dew-point.	Mean relative humidity, per cent.	Precipitation, in inches.			Wind.					Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness during daylight, tenths.	Total snowfall.
	Barometer above sea level, feet.	Thermometers above ground.	Anemometer above ground.	Actual, reduced to mean of 24 hours.	Sea level, reduced to mean of 24 hrs.	Departure from normal.	Mean max. + mean min. ÷ 2.	Departure from normal.	Maximum.	Date.	Mean maximum.	Minimum.	Date.	Mean minimum.	Greatest daily range.				Total.	Departure from normal.	Days with .01, or more.	Total movement miles.	Prevailing direction.	Maximum velocity. Miles per hour.	Maximum velocity. Direction.	Maximum velocity. Date.					
Up. Lake Reg—Cont.																													
Escanaba	612	40	82	29.33	29.99	+ .05	60.8	+ 0.2	90	20	70	36	15	52	31	57	53	77	1.84	— 1.8	8	6,570	s.	34	ne.	22	10	10	10	5.4	
Grand Haven	632	54	92	29.33	30.01	+ .05	64.2	— 0.5	85	18	73	40	11	55	28	59	56	73	0.98	— 1.5	4	7,831	s.	47	sw.	21	14	11	5	4.2	
Grand Rapids	707	121	162	29.27	30.03	+ .06	68.0	— 0.1	89	18	79	45	16	57	30	60	54	61	0.83	— 1.7	5	7,687	sw.	48	sw.	21	10	8	12	5.4	
Houghton	668	66	74	29.22	29.94	.00	61.9	+ 2.5	90	6	73	37	11	50	35	...	...	...	3.52	0.0	15	5,090	w.	26	w.	29	11	15	4	4.8	
Marquette	734	77	116	29.17	29.97	+ .03	61.4	+ 2.9	85	20	71	38	10	52	33	55	49	65	3.48	0.0	13	6,765	s.	40	w.	19	12	11	7	4.4	
Port Huron	638	70	120	29.35	30.04	+ .07	65.6	+ 1.8	90	23	75	40	16	56	27	60	56	70	2.03	— 1.2	7	7,362	sw.	60	w.	8	15	14	1	3.5	
Sault Sainte Marie	614	40	61	29.32	30.00	+ .04	59.6	+ 2.0	82	22	71	36	11	48	36	55	50	74	2.18	— 0.6	11	6,234	w.	38	w.	24	13	7	10	4.7	
Chicago	823	140	310	29.15	30.02	+ .06	68.4	+ 2.1	93	22	76	47	11	61	25	62	58	71	1.48	— 2.2	7	10,461	sw.	45	sw.	8	12	14	4	3.9	
Milwaukee	681	122	139	29.30	30.03	+ .08	64.4	+ 0.9	88	22	72	43	11	56	28	58	52	67	2.44	— 1.2	9	6,566	ne.	45	se.	21	15	11	4	3.6	
Green Bay	617	49	86	29.31	29.97	+ .02	64.7	— 0.4	88	22	76	38	1	54	32	58	53	66	1.74	— 1.8	9	7,449	se.	59	w.	22	11	8	11	5.4	
Duluth	1,133	11	47	28.73	29.94	+ .02	56.6	— 1.1	80	26	65	39	10	48	28	54	51	83	4.48	0.0	13	6,835	ne.	37	nw.	8	7	11	12	6.2	
North Dakota.							61.2	— 2.4										71	2.60	— 1.0									5.6	
Moorhead	940	8	57	28.89	29.89	— .01	61.8	— 2.5	86	26	71	36	14	52	32	58	55	78	2.99	— 1.1	11	6,659	se.	27	se.	4	10	9	11	5.6	
Bismarck	1,674	8	57	28.12	29.88	+ .01	61.8	— 2.4	87	26	72	37	10	51	39	56	51	70	2.29	— 1.2	10	9,459	nw.	42	w.	28	10	12	8	5.2	
Devils Lake	1,482	11	44	28.28	29.84	— .04	61.2	— 1.4	88	26	72	34	14	51	31	55	50	69	2.50	— 1.0	12	9,582	se.	40	w.	28	6	13	11	5.8	
Williston	1,875	14	56	27.86	29.81	— .05	60.2	— 3.3	90	26	70	32	9	50	34	54	49	67	2.64	— 0.9	12	7,983	se.	40	w.	13	10	8	12	5.8	
Upper Miss. Valley.							63.9	— 2.0										71	4.37	+ 0.1									5.1	
Minneapolis	.....	102	208	.....	.....	.....	65.1	.....	87	21	73	45	1	57	26	.....	.....	...	6.68	+ 2.7	11	10,204	se.	48	e.	22	11	9	10	5.2	
St. Paul	837	171	179	29.04	29.93	+ .01	64.6	— 2.8	85	21	72	45	14	57	24	58	54	69	5.14	+ 0.7	11	8,824	se.	54	sw.	22	11	11	8	4.9	
La Crosse	714	10	49	29.20	29.96	+ .03	66.2	— 2.0	86	6	76	44	15	57	29	.....	.....	...	5.87	+ 1.4	12	4,274	s.	25	se.	21	6	9	15	6.2	
Madison	974	70	78	28.96	29.99	+ .05	65.0	— 2.3	84	20	74	46	16	56	27	59	55	71	1.80	— 2.3	13	6,831	se.	33	sw.	8	9	14	7	5.0	
Charles City	1,015	3	49	28.91	29.97	+ .06	65.0	— 3.8	87	22	75	40	15	55	29	60	57	76	8.41	+ 3.3	15	6,097	se.	35	ne.	20	5	12	13	6.4	
Davenport	606	71	79	29.34	29.99	+ .05	68.8	— 2.1	90	22	78	46	10	59	27	63	59	72	4.57	+ 0.5	12	6,003	e.	30	n.	20	11	11	8	5.0	
Des Moines	861	84	101	29.05	29.94	+ .02	68.0	— 2.4	88	20	77	48	10	59	27	62	58	72	5.93	+ 1.0	15	6,927	se.	35	s.	18	4	16	10	6.4	
Dubuque	698	100	117	29.26	30.00	+ .07	67.4	— 2.2	88	22	76	49	15	58	26	61	56	68	2.21	— 2.3	15	4,726	se.	42	n.	20	9	12	9	5.0	
Keokuk	614	64	77	29.33	30.00	+ .06	70.2	— 2.3	90	22	79	48	16	61	23	64	60	73	4.32	0.0	13	5,371	e.	36	sw.	7	14	12	4	3.8	
Cairo	356	87	93	29.65	30.02	+ .05	75.2	0.0	94	23	83	58	16	67	23	64	60	73	3.15	— 1.2	9	5,740	se.	42	w.	8	7	15	8	5.7	
La Salle	536	56	64	29.46	30.03	+ .08	69.0	— 1.1	92	22	80	42	16	58	34	.....	.....	...	2.68	— 1.3	10	6,164	sw.	39	nw.	20	11	13	6	4.9	
Peoria	609	11	45	29.36	30.02	+ .07	69.4	— 1.5	92	21	80	45	11	59	34	63	59	69	4.09	— 0.2	11	5,973	s.	38	sw.	6	18	11	1	3.0	
Springfield, Ill.	644	10	92	29.33	30.00	+ .05	71.8	— 0.5	96	21	82	46	16	62	31	63	58	65	1.38	— 2.9	10	6,549	s.	31	s.	18	11	14	5	4.8	
Hannibal	534	75	109	29.42	29.99	+ .04	70.6	— 2.7	91	21	79	50	10	62	25	.....	.....	...	6.27	+ 2.8	16	6,837	e.	46	s.	23	11	9	10	5.3	
St. Louis	567	208	217	29.40	30.00	+ .05	73.2	— 1.9	92	22	81	52	16	65	22	65	61	70	3.02	— 1.4	10	6,874	se.	36	nw.	23	14	6	10	5.1	
Missouri Valley.							68.6	— 2.3										73	6.70	+ 2.4									5.5	
Columbia, Mo	784	11	84	29.17	29.98	+ .03	71.0	— 3.5	92	20	80	51	14	62	29	.....	.....	...	6.52	+ 2.1	15	5,620	s.	42	e.	12	8	17	5	5.2	
Kansas City	963	116	181	28.93	29.94	+ .02	71.3	— 1.7	88	20	79	55	15	63	24	65	62	75	9.75	+ 5.1	16	9,572	s.	57	n.	28	8	16	6	5.5	
Springfield, Mo	1,324	98	104	28.60	29.98	+ .03	71.4	— 0.9	87	20	79	52	14	64	24	66	63	78	5.51	+ 0.3	15	7,476	se.	43	w.	13	16	13	1	3.2	
Iola	984	11	50	28.92	29.94	+ .01	73.3	— 0.1	90	19	83	52	14	64	29	.....	.....	...	7.40	+ 2.7	15	5,976	s.	39	ne.	4	3	18	9	6.5	
Topeka	.....	85	89	.....	.....	.....	71.8	— 1.7	89	25	81	54	15	63	26	.....	.....	...	9.80	+ 5.0	17	7,192	s.	45	sw.	13	11	18	1	3.9	
Lincoln	1,189	11	84	28.66	29.89	— .01	69.2	— 2.4	91	22	78	50	14	60	28	63	59	73	11.24	+ 6.9	19	8,609	se.	63	sw.	22	6	12	12	6.3	
Omaha	1,105	115	121	28.76	29.92	+ .01	68.8	— 2.8	90	27	77	50	10	61	30	63	60	75	8.72	+ 3.7	19	6,780	se.	42	nw.	27	6	11	13	6.5	
Valentine	2,598	47	54	27.21	29.89	+ .03	64.2	— 2.9	94	21	75	44	29	53	37	56	51	70	2.91	— 0.9	17	8,511	s.	44	s.	6	6	19	5	5.4	
Sioux City	1,135	96	164	28.72	29.92	+ .02	66.6	— 2.8	90	21	75	44	10	58	28	.....	.....	...	4.67	+ 0.8	15	10,395	se.	60	sw.	22	6	12	12	6.2	
Pierre	1,572	70	78	28.23	29.87	.00	66.0	— 2.9	88	20	76	46	9	56	33	57	51	64	1.88	— 1.2	8	8,391	se.	39	nw.	27	8	11	11	5.5	
Huron	1,306	56	67	28.53	29.91	+ .03	64.1	— 2.5	93	21	74	40	10	54	31	59	56	79	6.94	+ 3.2	15	9,466	se.	43	s.	26	8	12	10	5.5	
Yankton	1,233	49	57	28.59	29.89	.00	65.6	— 3.8	93	21	75	40	10	56	27	.....	.....	...	5.03	+ 0.8	16	6,853	se.	37	nw.	23	4	13	13	6.5	
Northern Slope.							58.5	— 3.7										66	3.34	+ 1.1									4.7	
Havre	2,505	11	44	27.23	29.82	— .03	60.2	— 2.2	95	25	72	42	9	48	41	54	49	71	3.25	+ 0.4	11	6,477	nw.	38	sw.	27	13	16	1	4.2	
Miles City	2,371	26	48	27.36	29.87	+ .02	64.1	— 2.5	96	26	76	42	9	52	38	56	50	65	2.92	+ 0.2	13	4,766	s.	32	e.	19	12	15	3	4.3	
Helena	4,110	8	56	25.74	29.89	+ .01	56.1	— 4.5	88	25	67	36	20	45	39	47	40	62	4.76	+ 2.6	12	5,796	w.	38	w.	5	10	10	10	5.2	
Kalispell	2,962	8	34	26.85	29.87	— .02	56.2	— 2.6	85	25	68	37	20	44	38	48	43	69	2.48	+ 0.7	12	3,767	w.	25	sw.	26	8	17	5	4.8	
Rapid City	3,234	46	50	26.53	29.89	+ .04	60.8	— 3.0	89	26	71	40	1	50	36	55	51	71	4.28	+ 0.7	14	5,537	w.	34	sw.	4	21	4	5	3.5	
Cheyenne	6,088	56	64	23.98	29.84	.00	57.9	— 3.6	85	21	71	40	1	45	38	48	39	57	2.52	+ 1.0	14	6,716	s.	42	sw.	16	8	17	5	4.9	
Lander	5,372	26	36	24.60	29.87	+ .02	55.9	— 5.4	84	26	70	33	23	42	43	47	39	59	1.50	+ 0.4	11	2,914	w.	26	w.	19	10	17	3	4.2	
Sheridan	3,790	9	47	26.02	29.87	.....	57.4	.....	92	25	70	35	29	45	49	51	45	68	3.40	.....	12	4,631	nw.	40	sw.	26	12	7	11	5.2	
Yellowstone Park	6,200	11	48	23.85	29.90	+ .04	49.0	— 7.0	79	25	60	32	23	38	38	41	35	66	3.30	+ 1.7	18	5,231	sw.	38	sw.	26	6	11	13	6.7	
North Platte	2,821	11	51	27.01	29.88	+ .02	66.2	— 2.2	97	21	78	46	29	54	36	58	53	68	5.07	+ 1.8	14	6,404	se.	40	ne.	23	16	8	6	4.1	
Middle Slope.							70.6	— 1.1										63	7.04	+ 3.8									4.5	
Denver	5,291	129	136	24.68	29.83	— .01	64.6	— 1.8	92	21	79	42	19	50	44	50	38	46	1.68	+ 0.2	7	5,416	ne.	35	w.	18	11	17	2	4.2	
Leadville	10,248	7	...	.....	.....	.....	47.0	.....	70	21	61	24	4	33	.....	.....	.....	...	0.90	.....	6	.....	.....	.....	.....	.....	.....	.....	.....	.....	
Pueblo	4,685	80	86	25.22	29.79	— .04	69.5	+ 1.5	97	21	85	45	19	54	47	51	32	34	0.08	— 1.4	3	6,022	se.	45	ne.	12	18	12	0	2.6	
Concordia	1,398	42	50	28.46	29.90	.00	70.6	— 2.1	92	27	81	52	15	60	31	64	61	74	13.74	+ 8.8	17	6,465	se.	36	nw.	17	6	20	4	5.3	
Dodge	2,509	44	54	27.32	29.86	— .01	71.9	— 1.2	97	27	83	54	25	60	37	63	59	70	8.76	+ 5.4	13	10,276	se.	41	se.	27	14	14	2	3.8	
Wichita	1,358	90	120	28.52	29.92	+ .01	73.1	— 1.2	89	22	82	57	15	64	28	66	63	74	5.85	+ 1.1	13	9,305	s.	44	sw.	2	3	20	7	5.7	
Oklahoma	1,214	10	47	28.65	29.89	— .02	73.7	— 2.0	89	23	82	57	14	65	25	69	67	79	12.12	+ 9.0	16	12,861	s.	61	n.	13	6	16	8	5.6	
Southern Slope.							78.5	+ 1.3										57	0.88	— 2.0									3.4	
Abilene	1,738	45	54	28.10	29.85	— .03	80.9	+ 2.7	102	12	91	66	26	71	29	70	65	63	0.49	— 2.7	4	8,301	s.	34	ne.	10	11	14	5	4.5	
Amarillo	3,676	10	49	26.20	29.83	— .02	73.2	+ 1.2	96	21	86	52	2	61	36	62	56	63	1.73	— 1.3	5	11,011	s.	58	nw.	28	27	3	0	2.3	
Del Rio	944	8	57	28.86	29.82	— .03	84.4	+ 2.3	101	13	95	68	25	74	28	.....	.....	...	0.64	— 2.5	1	8,374	se.	30	ne.	30	19	7	4	3.8	
Roswell	3,578	9	57	26.28	29.82	+ .02	75.4	— 0.9	101	20	93	47	3	58	45	58	46	45	0.68	— 1.4	7	4,536	s.	28	se.	21	19	9	2	2.8	
Southern Plateau.							71.8	— 2.8										37	0.22	— 0.2									1.3	
El Paso	3,762	110	133	26.10	29.74	— .01	80.9	+ 1.3	101	28	94	55	5	67	37	54	26	18	0.00	— 0.6	0	9,342	w.	44	w.	17	25	5	0	1.2	
Santa Fe	7,013	33	89	23.26	29.74	— .07	63.0	— 3.2	83	28	78	38	4	49	35	46	26	27	0.60	— 0.4	3	6,817	sw.	36	e.	23	24	6	0	1.8	
Flagstaff	6,907	8	57	23.35	29.80	+ .02	55.6	— 3.7	83	30	74	23	4	37	47	41	26	40	0.69	+ 0.1	3	7,444	sw.	49	sw.	3	26	4	0	1.6	
Phoenix	1,108	50	56	28.63	29.76	+ .02	81.8	— 2.6	111	25	98	49	4	65	45	55	29	17	0.00	— 0.1	0	3,441	e.	22	w.	3	28	2	0	0.6	
Yuma	141	9	58	29.60	29.75	+ .01	81.4	— 3.3	112	30	101	50	1	62	46	60	45	36	0.00	0.0	0	4,465	sw.	35	nw.	3	30	0	0	0.1	
Independence	3,910	11	42	25.89	29.80	+ .02	68.3	— 5.1	95	30	84	36	3	52	39	49	28	25	T.	— 0.1	0	5,809	nw.	36	nw.	14	20	9	1	2.4	
Middle Plateau.							60.9	— 3.6										40	0.58	+ 0.1									3.4	
Reno	4,532	56	63	25.43	29.88	+ .02	59.4	— 1.6	91	30	75	32	22	44	46	44	32	45	0.24	0.0	3	4,557	w.	32	sw.	18	17	10	3	3.0	T.
Tonopah	6,089	12	20	24.03	29.86	.....	61.2	+ 1.0	85	25	73	26	3	49	31	43	23	26	T.	— 0.4	0	6,741	w.	41	nw.	2	13	17	0	3.3	
Winnemucca	4,344	18	56	25.57	29.92	+ .04	58.2	— 5.1	91	30	74	30	2	42	48	46	36	54	0.80	+ 0.2	4	3,957	ne.	34	sw.	20	18	6	6	3.2	3.1
Modena	5,479	10	43	24.55	29.81	— .01	59.8	— 3.4	87	25	77	32	4	43	46	44	28	37	0.37	— 0.1	4	8,818	sw.	68	sw.	2	15	10	5	3.6	T.
Salt Lake City	4,366	105	110	25.55	29.87	+ .02	60.8	— 7.3	90	25	72	40	3	50	36	49	40	52	1.81	+ 1.0	12	4,764	se.	30	sw.	13	15	8	7	4.0	
Durango	6,546	18	56	23.65	29.83	+ .01	59.1	— 3.6	84	24	77	30	4	41	46	42	26	37	0.24	— 0.5	3	4,842	nw.	36	s.	3	16	13	1	3.1	
Grand Junction	4,608	43	51	25.29	29.81	— .02	67.8	— 4.8	92	10	83	40	4	53	37	48	29	29	0.62	+ 0.3	4	4,859	nw.	25	w.	12	16	11	3	3.7	
Northern Plateau.							61.2	— 3.7										53	1.36	+ 0.2									4.4	
Baker City	3,471	48	58	26.40	29.96	+ .01	56.2	— 2.4	88	24	68	34	20	44	41	48	40	59	0.56	— 0.6	7	4,652	nw.	28	nw.	3	11	14	5	4.1	T.
Boise	2,739	78	86	27.10	29.93	+ .02	61.0	— 5.0	91	25	72	40	22	50	35	50	40	54	2.90	+ 2.0	12	4,215	nw.	28	nw.	16	13	12	5	4.3	
Lewiston	757	10	51	29.11	29.91	— .03	65.2	— 3.9	101	24	78	41	20	52	45	.....	.....	...	0.65	— 0.4	7	5,043	e.	45	w.	26	11	7	12	5.3	
Pocatello	4,477	46	54	25.44	29.91	+ .04	57.4	— 6.8	87	25	68	36	20	46	39	47	39	56	2.80	+ 1.8	15	5,633	se.	37	sw.	10	12	12	6	4.3	
Spokane	1,929	101	110	27.89	29.91	— .03	61.6	— 1.8	93	24	74	40	2	50	38	49	39	50	0.39	— 1.2	6	5,807	s.	32	sw.	26	11	15	4	4.8	
Walla Walla	1,000	71	79	28.87	29.94	— .02	66.1	— 2.1	98	24	78	41	2	54	37	53	42	48	0.84	— 0.4	7	5,330	s.	28	sw.	1	18	8	4	3.6	
N. Pac. Coast Reg.							56.5	— 1.1										77	0.98	— 1.1									6.0	
Blaine	57	4	....	29.95	30.01	.....	57.6	.....	81	30	67	42	7	48	.....	.....	.....	...	0.28	.....	8	.....	w.	.....	.....	.....	.....	.....	.....	.....	
North Head	211	11	56	29.86	30.08	+ .09	52.7	— 2.3	67	29	56	44	2	50	12	50	48	85	1.89	+ 0.1	16	9,473	nw.	39	nw.	20	2	11	17	7.7	
Port Crescent	259	12	29	29.79	30.08	+ .05	52.4	— 1.0	79	30	59	41	12	46	31	.....	.....	...	0.59	— 1.2	7	3,389	nw.	14	ne.	29	8	13	9	5.5	
Seattle	123	185	224	29.92	30.06	+ .06	58.8	— 1.3	85	30	67	43	2	51	27	54	51	80	0.15	— 1.6	6	5,641	s.	28	sw.	26	8	10	12	5.9	
Tacoma	213	113	120	29.79	30.02	— .01	58.6	— 0.8	86	30	68	44	2	50	30	53	48	72	0.32	— 1.8	5	4,602	sw.	20	sw.	1	10	12	8	5.0	

TABLE 1.—*Climatological data for U. S. Weather Bureau stations, June, 1908*—Continued.

Stations.	Elevation of instruments.			Pressure, in inches.			Temperature of the air, in degrees Fahrenheit.								Mean wet thermometer.	Mean temperature of the dew-point.	Mean relative humidity, per cent.	Precipitation, in inches.			Wind.					Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness during daylight, tenths.	Total snowfall.
	Barometer above sea level, feet.	Thermometers above ground.	Anemometer above ground.	Actual, reduced to mean of 24 hours.	Sea level, reduced to mean of 24 hrs.	Departure from normal.	Mean max. + mean min. ÷ 2.	Departure from normal.	Maximum.	Date.	Mean maximum.	Minimum.	Date.	Mean minimum.	Greatest daily range.				Total.	Departure from normal.	Days with .01, or more.	Total movement, miles.	Prevailing direction.	Maximum velocity. Miles per hour.	Maximum velocity. Direction.	Maximum velocity. Date.					
N. P. Coast Reg.—Cont.																													
Tatoosh Island	86	7	57	29.97	30.07	+ .05	51.4	— 1.6	70	30	55	45	8	48	20	49	48	89	1.84	— 2.3	12	7,121	sw.	35	w.	11	2	9	19	7.8	
Portland, Oreg.	153	68	106	29.88	30.04	+ .00	61.2	— 0.1	92	30	71	42	2	51	32	54	48	69	0.67	— 1.1	9	4,359	nw.	24	nw.	1	12	6	12	5.5	
Roseburg	510	9	57	29.51	30.06	+ .03	60.4	— 0.5	94	29	74	39	27	47	44	52	47	69	1.41	+ 0.3	10	2,687	nw.	16	nw.	2	13	7	10	4.8	
Mid. Pac. Coast Reg.							61.5	— 2.7							63			63	0.08	— 0.3									2.3	
Eureka	62	62	80	30.02	30.09	+ .04	52.2	— 2.4	64	24	56	45	2	48	17	50	48	87	0.19	— 0.9	4	6,380	nw.	37	sw.	29	18	8	4	3.6	
Mount Tamalpais	2,375	11	18	27.51	29.97	+ .02	59.5	.....	85	28	68	36	2	51	26	49	39	54	0.34	+ 0.2	2	12,930	nw.	77	nw.	2	24	4	2	1.7	
Point Reyes Light	490	7	18	29.43	29.95	.....	50.2	.....	60	28	54	42	3	47	10	.....	.....	.....	0.02	.....	1	22,805	nw.	76	nw.	1	15	5	10	4.6	
Red Bluff	332	50	56	29.53	29.88	.00	72.3	— 3.4	102	29	86	46	3	58	36	56	40	40	T.	— 0.5	0	4,609	nw.	27	se.	20	21	8	1	2.3	
Sacramento	69	106	117	29.83	29.90	+ .01	67.2	— 1.7	98	29	81	46	21	53	36	55	46	55	T.	— 0.2	0	6,898	s.	33	sw.	7	26	4	0	0.9	
San Francisco	155	200	204	29.81	29.98	+ .02	55.4	— 1.6	86	28	62	46	4	49	30	50	46	78	0.01	— 0.2	1	7,697	w.	30	w.	16	16	9	5	3.5	
San Jose	141	78	88	29.83	29.98	.....	60.4	— 4.6	96	28	75	38	3	46	48	.....	.....	.....	0.01	— 0.2	1	4,882	nw.	34	w.	2	27	2	1	2.0	
Southeast Farallon	30	9	17	29.97	30.00	.....	50.2	.....	55	13	52	46	2	48	7	.....	.....	.....	0.02	— 0.2	1	14,619	nw.	52	nw.	1	15	4	11	4.8	
S. Pac. Coast Reg.							63.7	— 2.4							65			65	0.00	— 0.1									2.2	
Fresno	330	67	70	29.54	29.89	+ .04	72.8	— 3.0	104	30	91	44	3	55	44	53	34	34	0.00	— 0.1	0	4,896	nw.	22	w.	2	28	1	1	1.0	
Los Angeles	338	116	123	29.56	29.92	+ .02	63.2	— 1.3	84	23	73	47	1	53	28	56	52	76	0.00	— 0.1	0	3,903	w.	20	sw.	3	22	5	3	3.0	
San Diego	87	94	102	29.84	29.94	+ .02	60.1	— 3.7	70	26	64	50	4	56	15	56	53	79	0.00	0.0	0	4,373	w.	18	nw.	13	28	1	1	1.9	
San Luis Obispo	201	47	54	29.77	29.99	+ .04	58.8	— 1.6	92	23	70	38	1	47	42	51	45	70	0.00	— 0.1	0	4,564	w.	24	w.	2	18	11	1	3.0	
West Indies.																														
Grand Turk	11	6	20	30.04	30.05	+ .04	82.8	.....	90	21	88	71	23	77	.....	.....	.....	.....	1.57	.....	11	.....	se.	.....	.....	.....	.....	.....	.....	.....	.....	
San Juan	82	48	90	29.95	30.04	+ .05	80.8	.....	91	5	86	71	30	75	16	75	72	76	2.67	— 2.2	15	7,882	se.	50	se.	16	14	10	6	4.5	
Panama.																														
Christobal	74	.....	.....	29.84	29.86	.....	79.0	.....	87	1	84	72	21	74	14	76	75	91	10.53	.....	23	4,824	se.	26	nw.	17	3	14	13	6.7	
Bas Obispo	40	.....	.....	29.69	29.87	.....	78.6	.....	90	29	85	69	20	72	20	74	74	93	6.55	.....	23	2,565	nw.	23	se.	1	0	8	22	8.0	
Ancon	.....	.....	.....	29.78	29.86	.....	79.9	.....	93	23	87	70	26	73	19	76	74	89	4.28	.....	17	4,506	nw.	25	nw.	27	0	2	28	8.5	
Alhajuela	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	69	21	72	.....	.....	.....	.....	11.06	.....	22	980	ne.	18	n.	9	.....	.....	.....	.....	
Bohio	.....	.....	.....	.....	.....	.....	79.2	.....	91	16	86	65	25	72	22	.....	.....	.....	20.02	.....	22	1,293	e.	19	ne.	20	.....	.....	.....	.....	
Gatun	.....	.....	.....	.....	.....	.....	79.0	.....	90	15	86	70	26	72	17	.....	.....	.....	13.33	.....	23	2,686	s.	18	ne.	26	.....	.....	.....	.....	

TABLE II.—*Accumulated amounts of precipitation for each 5 minutes, for storms in which the rate of fall equaled or exceeded 0.25 in any 5 minutes, or 0.80 inch in 1 hour, during June, 1908, at all stations furnished with self-registering gages.*

Stations.	Date.	Total duration. From—	Total duration. To—	Total amount of precipitation.	Excessive rate. Began—	Excessive rate. Ended—	Amount before excessive began.	Depths of precipitation (in inches) during periods of time indicated. 5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min.	100 min.	120 min.
Amarillo, Tex.	28	7:30 p. m.	8:30 p. m.	0.58	7:44 p. m.	8:17 p. m.	0.01	0.05	0.10	0.16	0.29	0.46	0.53	0.57	.....	.....	.....	.....	.....	.....	.....
Atlanta, Ga.	4	2:55 p. m.	5:10 p. m.	0.97	3:00 p. m.	3:35 p. m.	0.01	0.21	0.43	0.55	0.64	0.70	0.77	0.83	.....	.....	.....	.....	.....	.....	.....
Augusta, Ga.	4	2:07 p. m.	4:32 p. m.	2.18	2:09 p. m.	2:49 p. m.	0.01	0.36	0.84	1.08	1.25	1.47	1.62	1.74	1.81	.....	.....	.....	.....	.....	.....
Do	14	6:07 p. m.	10:45 p. m.	2.00	8:57 p. m.	9:25 p. m.	0.95	0.10	0.21	0.46	0.70	0.79	0.86	.....	.....	.....	.....	.....	.....	.....	.....
Do	23	12:37 p. m.	3:25 p. m.	1.16	1:00 p. m.	1:40 p. m.	0.06	0.08	0.22	0.38	0.46	0.63	0.78	0.84	0.89	.....	.....	.....	.....	.....	.....
Bentonville, Ark.	13	4:35 a. m.	7:10 a. m.	1.12	4:50 a. m.	5:15 a. m.	0.01	0.36	0.65	0.78	0.84	0.91	.....	.....	.....	.....	.....	.....	.....	.....	.....
Charles City, Iowa	20	5:37 p. m.	8:35 p. m.	2.43	5:45 p. m.	6:35 p. m.	0.01	0.16	0.35	0.63	0.83	0.92	1.02	1.20	1.48	1.66	1.81	.....	.....	.....	.....
					7:27 p. m.	7:40 p. m.	1.93	0.12	0.27	0.42	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Do	27	6:05 p. m.	7:20 p. m.	1.66	6:18 p. m.	7:06 p. m.	0.02	0.45	0.72	0.89	1.11	1.25	1.32	1.37	1.43	1.57	1.64	.....	.....	.....	.....
Cheyenne, Wyo.	2	9:15 p. m.	11:20 p. m.	1.16	9:40 p. m.	9:55 p. m.	0.05	0.16	0.62	0.84	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Columbia, Mo.	3	8:38 a. m.	11:27 a. m.	1.52	8:46 a. m.	9:36 a. m.	0.02	0.17	0.32	0.52	0.70	0.79	0.90	1.01	1.08	1.15	1.24	.....	.....	.....	.....
Do	23	10:40 a. m.	2:20 p. m.	1.14	12:00 noon	12:35 p. m.	0.35	0.11	0.16	0.37	0.46	0.58	0.67	0.72	.....	.....	.....	.....	.....	.....	.....
Do	29	D. N. a. m.	7:15 a. m.	0.92	1:13 a. m.	1:28 a. m.	0.01	0.43	0.53	0.62	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Columbia, S. C.	24	5:40 p. m.	7:38 p. m.	1.97	5:51 p. m.	7:03 p. m.	0.03	0.15	0.31	0.47	0.66	0.79	0.87	0.97	0.99	1.14	1.31	1.62	1.93	.....	.....
Columbus, Ohio	22	D. N. a. m.	D. N. a. m.	1.28	1:00 a. m.	1:29 a. m.	0.01	0.07	0.15	0.27	0.40	0.46	0.53	.....	.....	.....	.....	.....	.....	.....	.....
Concordia, Kans.	1-2	9:38 p. m.	2:15 a. m.	2.06	10:23 p. m.	10:56 p. m.	0.07	0.21	0.60	0.95	1.21	1.44	1.57	1.63	.....	.....	.....	.....	.....	.....	.....
Do	4	5:23 a. m.	6:40 a. m.	1.21	5:53 a. m.	6:33 a. m.	0.03	0.10	0.21	0.32	0.38	0.68	1.02	1.12	1.17	.....	.....	.....	.....	.....	.....
Do	5	3:30 a. m.	8:23 a. m.	3.10	3:34 a. m.	4:23 a. m.	0.02	0.32	0.57	0.75	0.85	0.91	1.05	1.19	1.39	1.55	1.62	.....	.....	.....	.....
					5:10 a. m.	5:29 a. m.	1.77	0.12	0.36	0.50	0.55	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Davenport, Iowa	6	11:49 a. m.	1:40 p. m.	1.96	12:17 p. m.	1:07 p. m.	0.01	0.26	0.56	0.80	0.95	1.06	1.24	1.35	1.63	1.75	1.87	.....	.....	.....	.....
Denver, Colo.	15	11:41 a. m.	12:45 p. m.	1.03	11:43 a. m.	12:06 p. m.	T.	0.35	0.70	0.81	0.90	0.96	.....	.....	.....	.....	.....	.....	.....	.....	.....
Des Moines, Iowa	6	2:30 a. m.	6:20 a. m.	1.13	5:17 a. m.	5:36 a. m.	0.39	0.09	0.32	0.48	0.54	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Do	27-28	10:05 p. m.	6:05 a. m.	1.82	10:21 p. m.	10:50 p. m.	0.01	0.26	0.58	0.72	0.90	0.98	1.05	.....	.....	.....	.....	.....	.....	.....	.....
Dodge City, Kans.	6	4:28 p. m.	9:20 p. m.	2.59	7:33 p. m.	8:25 p. m.	0.72	0.08	0.19	0.45	0.88	1.17	1.40	1.49	1.55	1.69	1.76	1.79	.....	.....	.....
Do	28	9:23 p. m.	10:15 p. m.	1.37	9:35 p. m.	10:00 p. m.	0.05	0.19	0.33	0.55	1.05	1.30	.....	.....	.....	.....	.....	.....	.....	.....	.....
Duluth, Minn.	8	10:00 a. m.	5:00 p. m.	1.00	12:22 a. m.	10:30 a. m.	0.08	0.24	0.30	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Do	22	10:31 a. m.	1:35 p. m.	0.62	10:33 a. m.	10:48 a. m.	0.02	0.14	0.29	0.36	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Elkins, W. Va.	14	3:05 p. m.	3:35 p. m.	0.58	3:08 p. m.	3:19 p. m.	0.01	0.34	0.55	0.57	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Fort Smith, Ark.	3	D. N. a. m.	4:58 a. m.	1.14	1:38 a. m.	2:03 a. m.	0.01	0.06	0.14	0.42	0.61	0.77	.....	.....	.....	.....	.....	.....	.....	.....	.....
Do	9	12:01 a. m.	2:08 a. m.	1.14	12:19 a. m.	12:50 a. m.	0.10	0.06	0.16	0.42	0.66	0.83	0.96	1.01	.....	.....	.....	.....	.....	.....	.....
Do	13	5:38 a. m.	8:05 a. m.	1.02	5:48 a. m.	6:17 a. m.	0.01	0.16	0.31	0.43	0.54	0.64	0.70	.....	.....	.....	.....	.....	.....	.....	.....
Fort Worth, Tex.	1	2:15 p. m.	4:05 p. m.	1.35	2:58 p. m.	3:37 p. m.	0.04	0.22	0.51	0.61	0.64	0.74	0.93	1.13	1.24	.....	.....	.....	.....	.....	.....
Hannibal, Mo.	5	12:40 p. m.	3:50 p. m.	0.77	12:56 p. m.	1:33 p. m.	0.01	0.17	0.31	0.40	0.45	0.45	0.51	0.60	0.64	.....	.....	.....	.....	.....	.....
Do	23	10:25 a. m.	2:00 p. m.	1.05	10:38 a. m.	11:15 a. m.	0.02	0.14	0.22	0.27	0.38	0.47	0.50	0.62	0.66	.....	.....	.....	.....	.....	.....
Do	29	D. N. a. m.	D. N. a. m.	1.11	1:18 a. m.	2:03 a. m.	0.10	0.10	0.15	0.16	0.21	0.39	0.51	0.62	0.73	0.80	.....	.....	.....	.....	.....
Hartford, Conn.	23	11:16 a. m.	12:37 p. m.	1.08	11:51 a. m.	12:26 p. m.	0.07	0.20	0.37	0.56	0.73	0.83	0.94	1.00	.....	.....	.....	.....	.....	.....	.....
Hatteras, N. C.	15	7:27 p. m.	11:50 p. m.	2.27	10:15 p. m.	11:15 p. m.	0.42	0.05	0.10	0.21	0.40	0.61	0.76	0.86	0.93	1.17	1.39	1.67	.....	.....	.....
Houghton, Mich.	18	8:15 p. m.	D. N. p. m.	0.71	9:05 p. m.	9:23 p. m.	0.02	0.20	0.48	0.66	0.69	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Huron, S. Dak.	17	6:10 p. m.	D. N. p. m.	3.41	7:37 p. m.	8:55 p. m.	0.02	0.20	0.29	0.35	0.40	0.42	0.50	0.64	0.75	0.79	0.80	0.98	1.89	.....	.....
					10:09 p. m.	10:55 p. m.	2.09	0.06	0.16	0.32	0.42	0.69	0.73	0.97	1.15	1.29	1.31	.....	.....	.....	.....
Iola, Kans.	4	8:24 p. m.	10:15 p. m.	0.83	8:54 p. m.	9:29 p. m.	0.02	0.08	0.21	0.35	0.45	0.49	0.65	0.79	.....	.....	.....	.....	.....	.....	.....
Do	5	12:20 a. m.	5:10 a. m.	0.80	4:12 a. m.	4:47 a. m.	0.10	0.09	0.19	0.29	0.42	0.46	0.55	0.65	.....	.....	.....	.....	.....	.....	.....
Do	12	6:15 a. m.	8:00 a. m.	1.29	6:55 a. m.	7:32 a. m.	0.03	0.38	0.70	0.85	0.94	1.03	1.11	1.17	1.20	.....	.....	.....	.....	.....	.....
Do	28-29	8:18 p. m.	5:30 a. m.	1.60	12:37 a. m.	12:52 a. m.	0.39	0.10	0.25	0.35	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Jacksonville, Fla.	4	9:50 a. m.	10:37 a. m.	0.64	9:59 a. m.	10:14 a. m.	0.01	0.15	0.41	0.62	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Jupiter, Fla.	5	11:26 a. m.	12:10 p. m.	1.25	11:26 a. m.	12:01 p. m.	0.09	0.14	0.30	0.60	0.71	0.83	1.13	1.22	.....	.....	.....	.....	.....	.....	.....
Do	5	4:35 p. m.	7:20 p. m.	2.02	5:47 p. m.	6:32 p. m.	0.01	0.25	0.41	0.35	0.78	1.23	1.62	1.70	1.81	1.91	.....	.....	.....	.....	.....
Kansas City, Mo.	13	1:50 a. m.	3:15 p. m.	2.70	2:10 a. m.	2:50 a. m.	0.01	0.20	0.28	0.35	0.44	0.48	0.53	0.68	0.77	.....	.....	.....	.....	.....	.....
					3:33 a. m.	3:53 a. m.	1.06	0.08	0.31	0.62	0.74	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Do	18-19	9:30 p. m.	7:05 a. m.	1.93	4:30 a. m.	5:45 a. m.	0.51	0.09	0.12	0.21	0.39	0.54	0.61	0.64	0.68	0.71	0.77	0.88	1.36	.....	.....
Keokuk, Iowa	13	7:20 a. m.	11:00 a. m.	1.04	10:07 a. m.	10:17 a. m.	0.64	0.13	0.24	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Do	23	9:15 a. m.	10:10 a. m.	0.84	9:15 a. m.	9:46 a. m.	0.00	0.15	0.43	0.67	0.69	0.76	0.81	0.83	.....	.....	.....	.....	.....	.....	.....
Key West, Fla.	1	5:47 p. m.	7:45 p. m.	1.01	5:53 p. m.	6:28 p. m.	T.	0.08	0.17	0.43	0.69	0.80	0.89	0.95	.....	.....	.....	.....	.....	.....	.....
Do	14	12:45 p. m.	1:25 p. m.	0.91	12:55 p. m.	1:15 p. m.	T.	0.16	0.31	0.76	0.88	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

TABLE II.—*Accumulated amounts of precipitation for each 5 minutes, etc.*—Continued.

Stations.	Date.	Total duration. From—	Total duration. To—	Total amount of precipitation.	Excessive rate. Began—	Excessive rate. Ended—	Amount before excessive began.	Depths of precipitation (in inches) during periods of time indicated. 5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min.	100 min.	120 min.
Key West, Fla	16	12:30 p. m.	6:35 p. m.	1.45	1:24 p. m.	1:54 p. m.	0.24	0.22	0.49	0.66	0.88	1.01	1.08	.....	.....	.....	.....	.....	.....	.....	.....
Do	16–17	10:55 p. m.	8:50 a. m.	2.35	1:07 p. m.	11:22 p. m.	0.01	0.18	0.33	0.39	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
					3:21 a. m.	3:56 a. m.	0.60	0.07	0.12	0.18	0.42	0.62	0.79	0.94	1.01	.....	.....	.....	.....	.....	.....
Knoxville, Tenn	3–4	3:30 p. m.	6:30 a. m.	1.05	5:51 p. m.	6:06 p. m.	0.05	0.38	0.57	0.65	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
La Crosse, Wis	22	6:31 p. m.	8:30 p. m.	1.15	7:12 p. m.	7:32 p. m.	0.03	0.14	0.32	0.54	0.72	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
La Salle, Ill	13	2:12 p. m.	3:05 p. m.	1.06	2:20 p. m.	2:50 p. m.	0.02	0.11	0.19	0.25	0.47	0.74	1.02	.....	.....	.....	.....	.....	.....	.....	.....
Lexington, Ky	4	11:03 a. m.	12:15 p. m.	0.75	11:12 a. m.	11:45 a. m.	0.03	0.06	0.14	0.28	0.39	0.56	0.65	0.67	.....	.....	.....	.....	.....	.....	.....
Lincoln, Nebr	1–2	8:40 p. m.	3:50 a. m.	2.29	1:11 a. m.	1:53 a. m.	1.40	0.07	0.11	0.15	0.19	0.25	0.32	0.43	0.64	0.68	.....	.....	.....	.....	.....
Do	5–6	11:10 p. m.	12:30 a. m.	0.75	11:26 p. m.	11:54 p. m.	0.02	0.11	0.15	0.29	0.44	0.56	0.64	.....	.....	.....	.....	.....	.....	.....	.....
Do	6–7	11:35 p. m.	5:45 a. m.	1.34	4:25 a. m.	4:52 a. m.	0.71	0.06	0.23	0.36	0.40	0.47	0.52	.....	.....	.....	.....	.....	.....	.....	.....
Louisville, Ky	3	4:45 p. m.	7:50 p. m.	0.70	5:46 p. m.	6:06 p. m.	0.01	0.12	0.34	0.52	0.58	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Do	10	2:35 p. m.	3:23 p. m.	0.66	2:41 p. m.	2:53 p. m.	0.01	0.16	0.52	0.61	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Do	10	3:58 p. m.	5:48 p. m.	0.55	4:29 p. m.	4:54 p. m.	0.01	0.17	0.22	0.29	0.36	0.52	.....	.....	.....	.....	.....	.....	.....	.....	.....
Marquette, Mich	7	4:00 p. m.	12:00md'nt	1.45	5:08 p. m.	5:30 p. m.	0.26	0.12	0.32	0.68	0.91	0.94	.....	.....	.....	.....	.....	.....	.....	.....	.....
Do	22	1:35 p. m.	6:30 p. m.	0.99	2:48 p. m.	3:03 p. m.	0.28	0.26	0.40	0.46	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Memphis, Tenn	2	2:19 p. m.	4:20 p. m.	0.93	2:55 p. m.	3:39 p. m.	0.06	0.07	0.13	0.21	0.29	0.36	0.54	0.68	0.77	0.83	.....	.....	.....	.....	.....
Do	4	10:40 a. m.	11:30 a. m.	0.81	10:46 a. m.	11:16 a. m.	0.01	0.19	0.28	0.41	0.64	0.70	0.78	.....	.....	.....	.....	.....	.....	.....	.....
Meridian, Miss	3–4	9:25 p. m.	D. N. a. m.	2.25	9:39 p. m.	9:57 p. m.	0.06	0.14	0.31	0.63	0.72	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
					11:01 p. m.	11:32 p. m.	1.04	0.07	0.18	0.37	0.47	0.54	0.79	.....	.....	.....	.....	.....	.....	.....	.....
Do	9	6:25 a. m.	12:15 p. m.	1.27	6:37 a. m.	7:02 a. m.	0.02	0.15	0.31	0.64	0.77	0.85	.....	.....	.....	.....	.....	.....	.....	.....	.....
Do	13–14	D. N. p. m.	D. N. a. m.	1.48	11:57 p. m.	12:20 a. m.	0.16	0.08	0.15	0.25	0.49	0.57	.....	.....	.....	.....	.....	.....	.....	.....	.....
					1:00 a. m.	1:15 a. m.	0.78	0.09	0.23	0.35	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Mount Weather, Va	15	8:01 a. m.	5:55 p. m.	1.59	2:45 p. m.	3:03 p. m.	0.36	0.21	0.35	0.46	0.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
North Platte, Nebr	22–23	10:15 p. m.	1:15 a. m.	1.87	10:46 p. m.	11:47 p. m.	0.03	0.10	0.14	0.19	0.21	0.28	0.45	0.66	0.73	0.98	1.42	1.71	.....	.....	.....
Oklahoma, Okla	9–10	11:20 p. m.	8:00 a. m.	2.08	12:41 a. m.	1:21 a. m.	0.01	0.09	0.40	0.75	1.02	1.22	1.35	1.46	1.52	.....	.....	.....	.....	.....	.....
Do	23–24	9:25 p. m.	D. N. a. m.	2.82	9:27 p. m.	10:27 p. m.	0.01	0.10	0.17	0.28	0.47	0.79	1.07	1.45	1.87	2.15	2.40	2.65	.....	.....	.....
Omaha, Nebr	5–6	10:25 p. m.	4:05 a. m.	1.22	11:35 p. m.	12:59 a. m.	0.03	0.07	0.19	0.30	0.39	0.44	0.52	0.62	0.72	0.77	0.80	0.87	0.98	1.08	.....
Do	27	7:20 p. m.	10:30 p. m.	1.34	7:22 p. m.	8:05 p. m.	T.	0.08	0.21	0.29	0.43	0.56	0.75	1.00	1.29	1.33	.....	.....	.....	.....	.....
Oswego, N. Y	23	6:20 p. m.	9:55 p. m.	1.45	7:39 p. m.	8:03 p. m.	0.28	0.25	0.62	0.86	0.96	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Palestine, Tex	29	2:06 p. m.	3:30 p. m.	1.25	2:16 p. m.	2:39 p. m.	0.01	0.13	0.55	0.90	1.11	1.18	.....	.....	.....	.....	.....	.....	.....	.....	.....
Pensacola, Fla	10	3:45 a. m.	10:25 a. m.	1.11	5:53 a. m.	6:08 a. m.	0.04	0.22	0.46	0.77	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Do	10	6:50 p. m.	10:15 p. m.	0.87	6:55 p. m.	7:25 p. m.	0.01	0.15	0.35	0.48	0.61	0.73	0.78	.....	.....	.....	.....	.....	.....	.....	.....
Peoria, Ill	13	11:25 a. m.	12:40 p. m.	0.78	11:37 a. m.	11:57 a. m.	0.03	0.10	0.24	0.57	0.71	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Do	13	1:05 p. m.	1:55 p. m.	1.29	1:08 p. m.	1:33 p. m.	0.01	0.21	0.53	0.92	1.17	1.28	.....	.....	.....	.....	.....	.....	.....	.....	.....
Port Huron, Mich	19	3:20 p. m.	5:00 p. m.	0.94	3:31 p. m.	3:56 p. m.	0.03	0.16	0.45	0.66	0.78	0.84	.....	.....	.....	.....	.....	.....	.....	.....	.....
Raleigh, N. C	20	6:28 p. m.	8:40 p. m.	1.18	6:31 p. m.	7:00 p. m.	0.01	0.32	0.61	0.77	0.90	0.98	1.05	.....	.....	.....	.....	.....	.....	.....	.....
Rapid City, S. Dak	2–3	7:05 p. m.	7:20 a. m.	1.42	2:37 a. m.	3:03 a. m.	0.47	0.09	0.23	0.28	0.34	0.46	0.51	.....	.....	.....	.....	.....	.....	.....	.....
Richmond, Va	3–4	5:08 p. m.	4:45 p. m.	3.20	7:40 a. m.	7:54 a. m.	2.10	0.09	0.26	0.36	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Do	21	6:16 p. m.	7:25 p. m.	0.91	6:16 p. m.	6:53 p. m.	0.00	0.13	0.22	0.36	0.51	0.71	0.79	0.84	0.88	.....	.....	.....	.....	.....	.....
Savannah, Ga	5	9:30 a. m.	1:15 p. m.	1.13	9:47 a. m.	10:36 a. m.	0.03	0.05	0.21	0.36	0.47	0.55	0.64	0.73	0.84	0.93	0.98	.....	.....	.....	.....
Do	25	4:10 p. m.	D. N. p. m.	1.44	4:22 p. m.	4:36 p. m.	0.01	0.14	0.35	0.48	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Sioux City, Iowa	7	6:50 p. m.	8:35 p. m.	0.86	6:50 p. m.	7:35 p. m.	0.00	0.30	0.35	0.40	0.44	0.47	0.52	0.59	0.66	0.73	.....	.....	.....	.....	.....
Springfield, Mo	13	D. N. a. m.	8:45 a. m.	0.91	4:59 a. m.	5:09 a. m.	0.02	0.22	0.32	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Do	23	7:48 p. m.	8:55 p. m.	0.80	7:51 p. m.	8:16 p. m.	0.01	0.23	0.47	0.56	0.66	0.72	.....	.....	.....	.....	.....	.....	.....	.....	.....
Syracuse, N. Y	14–15	7:17 p. m.	5:15 p. m.	1.21	9:32 p. m.	10:13 p. m.	0.07	0.08	0.13	0.24	0.29	0.36	0.42	0.51	0.67	0.71	.....	.....	.....	.....	.....
Tampa, Fla	24	1:35 p. m.	3:50 p. m.	1.49	2:25 p. m.	2:55 p. m.	T.	0.20	0.40	0.60	0.80	1.00	1.20	1.29	1.35	.....	.....	.....	.....	.....	.....
Thomasville, Ga	19	1:20 p. m.	2:55 p. m.	1.05	1:44 p. m.	2:29 p. m.	0.10	0.20	0.27	0.37	0.45	0.61	0.68	0.76	0.84	0.90	.....	.....	.....	.....	.....
Topeka, Kans	12	4:00 a. m.	8:15 a. m.	1.71	4:03 a. m.	4:28 a. m.	0.01	0.22	0.43	0.61	0.72	0.81	.....	.....	.....	.....	.....	.....	.....	.....	.....
Do	13	1:50 a. m.	11:55 a. m.	2.02	2:14 a. m.	3:03 a. m.	0.03	0.07	0.12	0.22	0.47	0.74	0.92	1.10	1.19	1.26	1.32	.....	.....	.....	.....
Do	30	5:58 p. m.	8:15 p. m.	1.56	6:09 p. m.	6:34 p. m.	0.03	0.08	0.21	0.51	0.93	1.16	.....	.....	.....	.....	.....	.....	.....	.....	.....
Vicksburg, Miss	3	9:50 p. m.	D. N. p. m.	1.12	10:30 p. m.	11:08 p. m.	0.09	0.16	0.25	0.37	0.47	0.66	0.94	1.01	.....	.....	.....	.....	.....	.....	.....
Wichita, Kans	12–13	11:50 p. m.	3:50 a. m.	1.00	11:59 p. m.	12:22 a. m.	0.01	0.12	0.25	0.45	0.56	0.59	.....	.....	.....	.....	.....	.....	.....	.....	.....
Do	27–28	11:20 p. m.	4:00 a. m.	1.01	11:29 p. m.	11:55 p. m.	0.01	0.09	0.29	0.36	0.43	0.50	0.51	.....	.....	.....	.....	.....	.....	.....	.....
Do	28–29	9:08 p. m.	D. N. a. m.	2.11	12:10 a. m.	12:43 a. m.	0.31	0.34	0.67	0.87	0.96	1.04	1.16	1.19	.....	.....	.....	.....	.....	.....	.....
Williston, N. Dak	16	2:42 p. m.	7:15 p. m.	0.81	4:13 p. m.	4:28 p. m.	0.09	0.10	0.32	0.42	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wilmington, N. C	11	1:48 p. m.	3:05 p. m.	1.02	2:09 p. m.	3:02 p. m.	0.02	0.05	0.14	0.30	0.48	0.52	0.52	0.52	0.55	0.64	0.90	.....	.....	.....	.....
Do	25–26	6:37 p. m.	D. N. a. m.	1.89	7:18 p. m.	7:53 p. m.	0.04	0.17	0.42	0.62	0.76	0.99	1.12	1.20	.....	.....	.....	.....	.....	.....	.....
Wythville, Va	14	2:40 p. m.	4:42 p. m.	1.23	3:49 p. m.	4:29 p. m.	0.04	0.12	0.36	0.40	0.50	0.69	0.93	1.07	1.18	.....	.....	.....	.....	.....	.....
Yankton, S. Dak	6–7	7:30 p. m.	6:15 a. m.	1.19	7:38 p. m.	7:48 p. m.	0.01	0.31	0.51	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

*Self-register not working. †Estimated.

TABLE III.—*Data furnished by the Canadian Meteorological Service, June, 1908.*

Stations.	Pressure.			Temperature.				Precipitation.		
	Actual, reduced to mean of 24 hours.	Sea level, reduced to mean of 24 hours.	Departure from normal.	Mean.	Departure from normal.	Mean maximum.	Mean minimum.	Total.	Departure from normal.	Total snowfall.
	Ins.	*Ins.*	*Ins.*	°	°	°	°	*Ins.*	*Ins.*	*Ins.*
St. Johns, N. F.	29.79	29.96	+.02	52.9	+ 1.3	62.0	43.7	2.07	—1.53	.....
Sydney, C. B. I.	29.93	29.97	+.02	57.9	+ 2.5	68.0	47.7	2.94	—0.29	.....
Halifax, N. S.	29.89	29.99	+.04	59.7	+ 2.0	70.6	48.8	4.32	+0.56	.....
Grand Manan, N. B	29.90	29.95	+.02	59.2	+ 3.0	68.6	49.9	1.30	—1.64	.....
Yarmouth, N. S	29.94	30.01	+.06	56.2	+ 1.2	63.8	48.5	2.02	—0.74	.....
Charlottetown, P. E. I	29.90	29.94	+.02	59.3	+ 1.9	68.0	50.6	1.93	—0.74	.....
Chatham, N. B	29.89	29.91	+.02	61.8	+ 1.8	74.5	49.2	2.98	—0.48	.....
Father Point, Que.	29.86	29.88	+.01	53.7	+ 0.7	62.3	45.1	5.83	+2.85	.....
Quebec, Que.	29.62	29.94	+.02	64.1	+ 2.9	76.0	52.3	2.47	—1.18	.....
Montreal, Que.	29.76	29.96	+.02	66.6	+ 1.7	75.7	57.5	0.90	—2.63	.....
Rockliffe, Ont.	29.38	29.98	+.04	63.1	+ 1.5	78.9	47.2	0.88	—2.28	.....
Ottawa, Ont.	29.73	30.05	+.11	66.2	+ 0.9	78.0	54.4	1.26	—1.66	.....
Kingston, Ont.	29.74	30.05	+.08	63.7	+ 0.3	71.2	56.1	3.45	+1.02	.....
Toronto, Ont	29.66	30.02	+.05	66.2	+ 2.8	77.3	55.2	3.07	+0.27	.....
White River, Ont	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Port Stanley, Ont	29.41	30.05	+.08	64.7	+ 0.9	75.5	53.8	2.03	—0.70	.....
Southampton, Ont.	29.33	.....	.....	63.2	+ 2.8	74.3	52.0	1.19	—1.16	.....
Parry Sound, Ont	29.34	30.02	+.06	64.0	+ 2.3	76.7	51.3	1.04	—1.28	....
Port Arthur, Ont.	29.22	29.93	—.01	56.9	+ 0.5	68.2	45.7	3.70	+0.97	....
Winnipeg, Man	29.02	29.84	—.05	62.1	— 0.1	73.1	51.0	3.11	—0.18	....
Minnedosa, Man	28.94	29.82	—.07	58.5	— 1.1	69.0	47.9	2.68	—0.32	....
Regina, Sask	27.83	.....	.....	58.5	— 1.4	70.7	46.4	5.73	+2.31	....
Medicine Hat, Alberta.	27.53	29.77	—.08	61.5	— 0.5	72.7	50.3	1.66	—1.10	....
Swift Current, Sask.	27.30	29.83	—.04	58.8	— 1.2	70.8	46.9	2.98	+0.31	....
Calgary, Alberta	26.35	29.84	.00	55.2	— 0.8	66.1	44.2	7.26	+4.81	....
Banff, Alberta	25.33	29.85	+.01	51.6	+ 0.1	62.8	40.3	2.61	—0.72	....
Edmonton, Alberta.	27.56	29.82	—.02	55.5	— 1.4	65.7	45.3	5.36	+2.50	....
Prince Albert, Sask.	28.24	29.77	—.10	56.2	— 1.5	67.6	44.9	7.36	+4.85	....
Battleford, Sask	28.08	29.79	—.07	58.6	— 0.9	70.3	46.9	7.60	+4.29	....
Kamloops, B. C.	28.58	29.77	—.10	66.2	+ 2.4	78.2	54.1	0.89	—0.53	....
Victoria, B. C.	29.92	30.01	.00	58.7	+ 2.4	67.9	49.5	0.09	—1.11	....
Barkerville, B. C.	25.66	29.94	+.07	50.4	— 0.3	61.6	39.1	4.74	+1.26	....
Hamilton, Bermuda.	30.01	30.17	+.05	75.2	+ 0.2	80.1	70.3	2.64	—3.31	....
Dawson, Yukon	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

TABLE IV.—*Heights of rivers referred to zeros of gages, June, 1908.*

Stations.	Distance to mouth of river.	Flood stage on gage.	Highest water.		Lowest water.		Mean stage.	Monthly range.
			Height.	Date.	Height.	Date.		
Republican River.	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
Clay Center, Kans.	42	18	21.6	6	7.1	1	12.7	14.5
Smoky Hill-Kansas River.								
Abilene, Kans.	254	22	24.0	11	0.8	1	17.3	23.2
Manhattan, Kans.	160	18	24.8	7	8.2	2	15.5	16.6
Topeka, Kans.	87	21	28.0	9	11.2	2	18.2	16.8
Missouri River.								
Townsend, Mont.	2,504	11	10.4	14–16	8.0	1	9.5	2.4
Fort Benton, Mont.	2,285	12	15.3	7	6.1	20	8.9	9.2
Wolfpoint, Mont.	1,952	17	12.8	14	5.2	1	8.0	7.6
Bismarck, N. Dak.	1,309	14	15.1	19	5.8	1	11.2	9.3
Pierre, S. Dak.	1,114	14	11.4	22	5.9	1–3	9.1	5.5
Sioux City, Iowa	784	17	15.2	23	10.7	5	13.5	4.5
Blair, Nebr.	705	15	15.9	26	11.9	1	14.3	4.0
Omaha, Nebr.	669	18	19.1	25, 26	14.1	1	17.4	5.0
Plattsmouth, Nebr.	641	17	12.0	25	7.4	1	10.8	4.6
St. Joseph, Mo.	481	10	14.9	14, 15	8.3	1	13.2	6.6
Kansas City, Mo.	388	21	30.2	15	17.6	2	25.3	12.6
Glasgow, Mo.	231	21	27.2	18	17.8	1	23.2	9.4
Boonville, Mo.	199	20	28.2	18	18.3	1	23.8	9.9
Hermann, Mo.	103	24	25.0	20	17.0	1	21.3	8.0
Minnesota River.								
Mankato, Minn.	127	18	21.2	26	10.1	18	14.4	11.1
St. Croix River.								
Stillwater, Minn.	23	11	14.6	4, 5, 30	12.3	24, 25	13.6	2.3
Illinois River.								
La Salle, Ill.	197	18	22.1	1	15.0	30	18.0	7.1
Peoria, Ill.	135	14	18.9	1	12.4	29	15.4	6.5
Conemaugh River.								
Johnstown, Pa	64	7	2.8	1, 2	1.0	28–30	1.8	1.8
Allegheny River.								
Warren, Pa.	177	14	3.8	1	0.9	22–24	16.6	2.9
Parker, Pa.	73	20	4.9	1	1.4	14, 15, 21, 30	2.2	3.5
Freeport, Pa.	29	20	8.7	1	2.6	30	4.1	6.1
Springdale, Pa	17	—	12.4	1	7.2	30	8.6	5.2
Youghiogheny River.								
Confluence, Pa.	59	10	1.8	1	0.4	{14, 15, 18, 19, 27–30}	7.0	1.4
West Newton, Pa	15	23	3.2	1	0.8	15	1.5	2.4
Monongahela River.								
Fairmont, W. Va.	119	25	16.5	1	14.3	29, 30	14.7	2.2
Greensboro, Pa.	81	18	8.8	1	6.7	28–30	7.4	2.1
Lock No. 4, Pa.	40	28	10.4	1	6.9	29, 30	7.8	3.5
Muskingum River.								
Zanesville, Ohio	70	25	11.1	1	8.1	19, 21, 28–30	8.7	3.0
Little Kanawha River.								
Creston, W. Va.	38	20	2.4	23	1.5	16, 17	1.9	0.9
New-Great Kanawha River.								
Hinton, W. Va.	153	14	5.4	6	2.3	30	2.9	3.1
Charleston, W. Va.	58	30	9.0	6	4.7	12, 13	6.7	4.3
Scioto River.								
Columbus, Ohio	110	17	4.0	1	2.0	9, 12, 15–19	2.6	2.0
Licking River.								
Falmouth, Ky.	36	25	2.2	5, 6	1.0	28–30	1.6	1.2
Kentucky River.								
Beattyville, Ky	254	30	3.0	6	0.2	19–21, 28, 29	1.0	2.8
Frankfort, Ky.	65	31	6.8	5	5.5	23–26	5.8	1.3
Wabash River.								
Terre Haute, Ind.	171	16	5.9	1	1.9	28–30	3.1	4.0
Mount Carmel, Ill.	75	15	8.0	1	3.7	30	5.1	4.3
Cumberland River.								
Burnside, Ky.	518	50	3.2	6	0.0	23, 25–27	1.1	3.2
Celina, Tenn.	383	45	4.6	8	1.1	27–29	2.6	3.5
Carthage, Tenn.	308	40	6.8	5, 6	1.3	29, 30	3.1	5.5
Nashville, Tenn.	193	40	11.6	7	7.5	29, 30	9.3	4.1
Clarksville, Tenn.	126	43	14.7	11	3.0	29	7.5	11.7
Clinch River.								
Speers Ferry, Va.	156	20	9.0	23	0.5	15, 16, 20	1.3	8.5
Clinch River—Cont'd.								
Clinton, Tenn	52	25	9.0	25	4.0	17	5.2	5.0
South Fork Holston River.								
Bluff City, Tenn.	35	12	3.3	5	1.0	14	1.7	2.3
Holston River.								
Rogersville, Tenn.	103	14	4.8	6	2.4	21, 23, 30	3.0	2.4
French Broad River.								
Asheville, N. C.	144	4	0.4	6	— 0.2	28–30	0.1	0.6
Dandridge, Tenn.	46	12	2.7	16	0.9	30	1.4	1.8
Tennessee River.								
Knoxville, Tenn.	635	12	4.0	7, 17	1.2	30	2.4	2.8
Loudon, Tenn.	590	25	3.8	1	1.8	30	2.6	2.0
Kingston, Tenn.	556	25	4.2	5	2.4	23	3.3	1.8
Chattanooga, Tenn.	452	33	6.2	8, 9	3.3	26	5.3	2.9
Bridgeport, Ala	402	24	4.0	4	1.9	25	3.0	2.1
Guntersville, Ala.	349	31	6.7	4, 8, 9	3.9	26, 27	5.5	2.8
Florence, Ala.	255	16	4.7	5	1.6	28	3.0	3.1
Riverton, Ala.	225	26	8.0	5	3.7	27, 28	5.8	4.3
Johnsonville, Tenn.	95	21	9.0	7	3.7	29, 30	6.1	5.3
Ohio River.								
Pittsburg, Pa.	966	22	6.9	1	1.9	10	5.2	5.0
Coraopolis, Pa	956	25	8.1	1	2.3	14	4.3	5.8
Beaver Dam, Pa.	937	27	11.4	1	4.0	28	5.9	7.4
Wheeling, W. Va.	875	36	10.3	1	3.9	15, 27, 30	5.8	7.0
Parkersburg, W. Va.	785	36	11.3	1	4.7	29	6.8	6.6
Point Pleasant, W. Va.	703	39	13.9	1	3.7	30	6.9	10.2
Huntington, W. Va	660	50	17.8	2	7.0	30	10.8	10.8
Catlettsburg, Ky.	651	50	17.4	2	5.8	16	10.0	11.6
Portsmouth, Ohio	612	50	17.8	2	7.2	16	11.1	10.6
Maysville, Ky.	559	50	17.9	3	7.6	17	11.7	10.3
Cincinnati, Ohio.	499	50	17.4	1	9.2	18	12.9	8.2
Madison, Ind	413	46	17.0	1	8.0	19	11.8	9.0
Louisville, Ky.	367	28	7.6	1	4.0	19, 20	5.5	3.6
Evansville, Ind.	184	35	19.8	1	6.9	23	11.4	12.9
Mount Vernon, Ind.	148	35	20.3	1	6.8	24	11.4	13.5
Paducah, Ky.	47	40	24.3	1	19.2	30	21.2	5.1
Cairo, Ill.	1	45	36.5	1	34.0	30	35.5	2.5
Neosho River.								
Iola, Kans.	262	10	12.5	19	1.0	28	5.2	11.5
Oswego, Kans.	184	20	16.9	22	2.0	29	11.1	14.9
Fort Gibson, Okla.	3	22	31.0	15	10.0	29, 30	18.8	21.0
Canadian River.								
Calvin, Okla.	99	10	11.8	10	3.6	29	6.0	8.2
Black River.								
Blackrock, Ark.	67	12	11.6	1	6.1	29	9.4	5.5
White River.								
Calicorock, Ark	272	18	11.0	2	1.7	29	4.7	9.3
Batesville, Ark.	217	18	12.6	3	3.8	28–30	6.8	8.8
Clarendon, Ark.	75	30	28.5	1	21.5	30	25.4	7.0
Arkansas River.								
Wichita, Kans.	832	10	3.9	14	— 1.0	1, 27, 28	0.5	4.9
Tulsa, Okla.	551	16	15.0	8	4.7	30	9.5	10.3
Webbers Falls, Okla.	465	23	23.6	15	10.0	30	18.7	13.6
Fort Smith, Ark	403	22	28.4	13	10.0	30	21.9	18.4
Dardanelle, Ark.	256	21	25.9	15	12.4	30	21.8	13.5
Little Rock, Ark.	176	23	26.3	16, 17	14.0	30	23.4	12.3
Pine Bluff, Ark.	121	25	28.9	1	17.7	29	26.4	11.2
Yazoo River.								
Greenwood, Miss	175	38	16.1	17, 18	8.3	5	13.0	7.8
Yazoo City, Miss.	80	25	22.8	11, 12, 14	20.9	30	22.2	1.9
Ouachita River.								
Camden, Ark.	304	39	31.0	1	6.9	30	21.2	24.1
Monroe, La.	122	40	35.4	2	31.6	30	34.0	3.8
Red River								
Arthur City, Tex.	688	27	32.1	7	15.2	27, 30	24.9	16.9
Fulton, Ark.	515	28	34.0	2, 3	28.2	30	32.6	5.8
Shreveport, La.	327	29	35.2	15	26.0	3	32.0	9.2
Alexandria, La.	118	36	41.2	30	36.4	1, 2	38.5	4.8

TABLE IV.—*Heights of rivers referred to zeros of gages*—Continued.

Stations.	Distance to mouth of river.	Flood stage on gage.	Highest water.		Lowest water.		Mean stage.	Monthly range.
			Height.	Date.	Height.	Date.		
Mississippi River.	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
Fort Ripley, Minn	2,082	10	21.0	11	8.5	30	9.4	2.5
St. Paul, Minn.	1,954	14	16.8	29	12.2	22–24	14.2	4.6
Red Wing, Minn.	1,914	14	11.5	5	9.6	22, 25–27	10.5	1.9
Reeds Landing, Minn.	1,884	12	10.0	5, 6, 30	8.7	27	9.4	1.3
La Crosse, Wis.	1,819	12	11.4	25	10.4	1	11.0	1.0
Prairie du Chien, Wis.	1,759	18	13.7	21	11.6	1	13.0	2.1
Dubuque, Iowa.	1,699	18	14.7	22	12.1	1	13.8	2.6
Clinton, Iowa	1,629	16	13.4	24–26	10.9	1	12.7	2.5
Leclaire, Iowa	1,609	10	8.3	25, 26	6.5	1	7.7	1.8
Davenport, Iowa	1,593	15	12.0	25–27	10.3	1	11.5	1.7
Muscatine, Iowa	1,562	16	13.4	26, 27	11.8	1	12.9	1.6
Galland, Iowa	1,472	8	7.4	9	6.3	24	6.7	1.1
Keokuk, Iowa	1,463	15	14.2	9	12.1	25, 26	13.1	2.1
Warsaw, Ill	1,458	18	17.2	1, 7–9	15.1	20, 21	16.2	2.1
Hannibal, Mo	1,402	18	17.6	1	13.4	22, 26	15.0	4.2
Grafton, Ill	1,306	23	23.8	18, 19	19.7	30	22.1	4.1
St. Louis, Mo	1,264	30	34.9	20, 21	27.6	1	31.9	7.3
Chester, Ill	1,189	30	30.7	20–23	24.0	1	27.9	6.7
Cape Girardeau, Mo.	1,128	28	34.2	22	27.7	1	31.6	6.5
New Madrid, Mo.	1,003	34	30.4	1	29.0	30	29.9	1.4
Memphis, Tenn	843	33	30.7	1	28.4	30	29.4	2.3
Helena, Ark.	767	42	41.9	1	37.1	30	38.8	4.8
Arkansas City, Ark.	635	42	49.9	2–4	45.9	30	48.3	4.0
Greenville, Miss.	595	42	44.7	2–5	40.0	30	42.9	4.7
Vicksburg, Miss.	474	45	47.9	6–10	46.0	30	47.3	1.9
Natchez, Miss.	373	46	48.9	14	47.4	30	48.3	1.5
Baton Rouge, La.	240	35	39.6	15–17	38.0	1	39.1	1.6
Donaldsonville, La	188	28	31.6	16, 18, 19	30.2	1	31.1	1.4
New Orleans, La.	108	18	20.0	19, 22	19.0	1	19.6	1.0
Atchafalaya River.								
Simmesport, La.	127	41	45.2	19	43.6	1	44.7	1.6
Melville, La.	103	37	39.7	22, 23	38.7	1	39.4	1.0
Hudson River.								
Troy, N. Y.	154	14	6.3	2	4.2	29, 30	4.8	2.1
Albany, N. Y.	147	12	5.2	1, 2	1.3	22	3.3	3.9
Delaware River.								
Hancock (E. Branch), N. Y.	287	12	3.9	1	2.7	28–30	3.1	1.2
Hancock (W. Branch), N. Y.	287	10	3.6	1	2.5	29, 30	2.9	1.1
Port Jervis, N. Y.	215	14	1.7	1	— 0.2	2•, 30	0.5	1.9
Phillipsburg, N. J.	146	26	3.9	1	1.0	29, 30	2.0	2.9
Trenton, N. J.	92	18	3.3	·1	1.1	28, 30	1.8	2.2
North Branch Susquehanna.								
Binghamton, N. Y.	183	14	2.9	1, 2	1.9	30	2.2	1.0
Wilkes-Barre, Pa.	60	17	6.2	2	3.1	24, 28, 30	3.9	3.1
West Branch Susquehanna.								
Williamsport, Pa.	39	20	7.3	1	0.9	29, 30	2.4	6.4
Susquehanna River.								
Harrisburg, Pa.	69	17	5.1	1	1.5	29, 30	2.5	3.6
Shenandoah River.								
Riverton, Va.	58	22	1.6	6	— 0.6	29, 30	0.5	2.2
Potomac River.								
Cumberland, Md.	290	8	3.6	1	2.4	15–30	2.7	1.2
Harpers Ferry, W. Va.	172	18	5.5	1	0.2	27	1.9	5.3
James River.								
Lynchburg, Va.	260	20	3.8	6	1.2	29, 30	2.1	2.6
Columbia, Va.	167	18	9.9	16	4.7	29, 30	6.2	5.2
Richmond, Va.	111	10	3.0	5, 17	0.3	21, 28	1.2	2.7
Roanoke River.								
Clarksville, Va	196	12	7.8	6	0.6	3	2.1	7.2
Weldon, N. C.	129	30	34.1	7	13.9	2, 4, 28, 30	17.1	20.2
Tar River.								
Greenville, N. C.	21	22	6.8	7, 29	3.8	4	5.2	3.0
Deep River.								
Moncure, N. C.	171	25	9.6	5	6.1	2	8.0	3.5
Cape Fear River.								
Fayetteville, N. C.	112	38	10.0	6	3.1	1	5.4	6.9
Pedee River.								
Cheraw, S. C.	149	27	10.3	7	2.4	1, 4	4.0	7.9
Smiths Mills, S. C.	51	16	8.6	10, 11	4.0	25	5.8	4.6
Lynch Creek.								
Effingham, S. C.	35	12	5.7	26	3.7	22	4.5	2.0
Black River.								
Kingstree, S. C.	45	12	5.5	9, 30	2.0	22, 23	3.7	3.5
Catawba-Wateree River.								
Mount Holly, N. C.	143	15	3.0	5	1.8	{1–4, 20, 23–25, 28–30}	2.0	1.2
Catawba, S. C	107	11	4.1	25	2.5	4, 30	3.3	1.6

Stations.	Distance to mouth of river.	Flood stage on gage.	Highest water.		Lowest water.		Mean stage.	Monthly range.
			Height.	Date.	Height.	Date.		
***Catawba-Wateree River*-Con.**	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
Camden, S. C.	37	24	11.9	26	6.5	6, 12	7.8	5.4
Congaree River.								
Columbia, S. C.	52	15	7.8	26	1.1	14	2.3	6.7
Santee River.								
Ferguson, S. C.	82	12	12.7	30	8.0	4–8, 11–16	9.1	4.7
Savannah River.								
Calhoun Falls, S. C.	347	15	5.2	15	2.8	30	3.5	2.4
Augusta, Ga.	268	32	17.8	25	8.0	3, 4	10.3	9.8
Oconee River.								
Dublin, Ga	79	30	6.4	25	0.8	17	2.3	5.6
Ocmulgee River.								
Macon, Ga.	134	18	11.6	23	3.4	30	5.2	8.2
Abbeville, Ga.	51	11	7.6	5, 6	4.0	17	6.0	3.6
Flint River.								
Montezuma, Ga.	152	20	6.4	1, 7	3.5	30	4.8	2.9
Albany, Ga.	99	20	4.5	9, 10	2.0	26	3.1	2.5
Bainbridge, Ga.	22	22	8.4	12, 13	7.0	11	7.6	1.4
Chattahoochee River.								
West Point, Ga	174	20	4.7	6	2.5	30	3.5	2.2
Eufaula, Ala	90	40	7.0	8	2.7	30	4.6	4.3
Alaga, Ala.	30	25	8.6	1	5.0	30	6.6	3.6
Coosa River.								
Rome, Ga.	266	30	3.0	22	1.6	20, 21, 29, 30	2.1	1.4
Gadsden, Ala.	162	22	3.9	1	1.6	30	2.7	2.3
Lock No. 4, Ala.	113	17	3.5	1	1.2	30	2.1	2.3
Wetumpka, Ala	12	45	10.5	1	3.8	30	5.9	6.7
Alabama River.								
Montgomery, Ala.	323	35	6.8	1	2.3	30	3.8	4.5
Selma, Ala	246	35	9.2	1	3.1	30	5.0	6.1
Black Warrior River.								
Tuscaloosa, Ala.	90	43	14.8	1	5.6	30	8.4	9.2
Tombigbee River.								
Columbus, Miss	316	33	10.5	9	— 1.9	28–30	2.3	12.4
Demopolis, Ala.	168	35	17.3	9	2.1	30	9.9	15.2
Pascagoula River.								
Merrill, Miss.	78	20	6.9	14	3.6	30	5.7	3.3
Pearl River.								
Columbia, Miss.	110	18	12.6	1	5.1	30	7.1	7.5
Sabine River.								
Logansport, La.	315	25	28.0	1	6.0	30	14.2	22.0
Neches River.								
Beaumont, Tex.	18	10	7.3	1	1.4	29	3.6	5.9
Trinity River.								
Dallas, Tex.	320	25	32.5	1	7.8	29	20.3	24.7
Long Lake, Tex.	211	35	51.8	4	18.3	30	36.2	33.5
Liberty, Tex	20	25	28.1	17–20	26.7	8–10	27.2	1.4
Brazos River.								
Waco, Tex.	285	22	11.8	5	3.4	30	5.4	8.4
Hempstead, Tex	140	40	42.6	2	5.0	28	15.8	37.6
Booth, Tex	61	39	42.3	6, 7	6.5	30	21.5	35.8
Colorado River.								
Austin, Tex.	214	18	4.8	1	1.8	24–28	2.8	3.0
Columbus, Tex.	98	24	23.8	1	7.7	30	10.6	16.1
Red River of the North.								
Moorhead, Minn	284	26	14.7	13	9.8	1, 5		4.9
Rio Grande.								
El Paso, Tex.	1,030	14	11.8	1	9.4	30	10.7	2.4
San Marcial, N. Mex.	1,233	11	10.6	19	9.5	30	10.2	1.1
Snake River.								
Lewiston, Idaho	144	24	14.1	15, 16	7.8	1	11.5	6.3
Riparia, Wash.	67	30	13.7	17	8.5	3, 4	11.4	5.2
Columbia River.								
Wenatchee, Wash	473	40	41.0	18	30.0	1	36.4	11.0
Umatilla, Oreg	270	25	21.9	17, 18	15.6	1, 2	19.0	6.3
The Dalles, Oreg.	166	40	37.1	18	24.8	2	31.6	12.3
Willamette River.								
Albany, Oreg.	118	20	5.0	23	3.1	30	3.7	1.9
Portland, Oreg.	12	15	21.2	20, 21	14.1	4, 5	18.0	7.1
Sacramento River.								
Red Bluff, Cal.	265	23	3.0	1, 2	1.9	29, 30	2.4	1.1
Colusa, Cal	156	28	7.3	1	4.3	30	5.8	3.0
Knights Landing, Cal.	99	18	8.4	1	3.9	30	6.2	4.5
Sacramento, Cal.	64	25	15.5	1	9.9	30	12.6	5.6
San Joaquin River.								
Pollasky, Cal.	203	10	1.9	15	1.0	5	1.4	0.9
Firebaugh, Cal	148	14	4.3	1	1.3	7, 25, 26	2.4	3.0
Lathrop, Cal.	49	14	11.3	1	4.6	30	7.9	6.7

Honolulu, T. H., latitude 21° 19′ north, longitude 157° 30′ west; barometer above sea, 38 feet; gravity correction, —0.057 inch, applied. June, 1908.

Day.	Pressure, in inches.*		Air temperature, degrees Fahrenheit.				Moisture.				Wind, in miles per hour.				Precipitation, inches.		Clouds.					
							8 a. m.		8 p. m.		8 a. m.		8 p. m.				8 a. m.			8 p. m.		
	8 a. m.	8 p. m.	8 a. m.	8 p. m.	Maximum.	Minimum.	Wet.	Relative humidity.	Wet.	Relative humidity.	Direction.	Velocity.	Direction.	Velocity.	8 a. m.	8 p. m.	Amount.	Kind.	Direction, from.	Amount.	Kind.	Direction, from
							°	%	°	%												
1	30.09	30.08	77.0	73.5	80	70	67.4	60	66.0	67	ne.	5	e.	12	0.00	0.00	2	Cu.	e.	0	0	0
2	30.11	30.09	76.0	74.0	80	71	66.0	59	66.0	63	ne.	8	ne.	10	0.00	0.00	7 3	Ci.-s. Cu.	0 e.	1	A.-s.	nw.
3	30.10	30.06	74.5	73.5	80	71	66.6	66	65.0	63	ne.	12	e.	6	T.	0.00	6 2	Ci. Cu.	nw. e.	1	Cu.	ne.
4	30.06	30.04	75.2	74.0	80	72	65.3	59	67.0	69	e.	14	e.	10	0.00	0.00	2	Cu.	e.	1	Cu.	ne.
5	30.07	30.07	76.0	73.5	80	70	67.1	62	69.0	80	ne.	8	e.	15	T.	T.	2	Cu.	e.	9	N.	ne.
6	30.11	30.08	77.0	74.0	80	71	68.0	63	67.0	69	ne.	13	e.	10	0.01	0.00	2 1	Ci.-s. Cu.	sw. e.	Few	Cu.	ne.
7	30.10	30.05	76.0	73.5	80	71	66.0	59	67.0	71	e.	4	ne.	8	0.00	0.00	7	Cu.	e.	7	Cu.	e.
8	30.04	30.00	76.0	75.0	81	71	66.0	59	66.0	62	ne.	5	e.	12	0.00	0.00	5	Cu.	e.	9	Cu.	ne.
9	30.03	30.02	77.0	73.0	81	71	67.0	57	69.0	82	n.	5	ne.	6	0.00	T.	4	Cu.	e.	10	N.	e.
10	30.05	30.05	77.5	75.0	81	71	68.0	62	67.0	66	e.	5	e.	8	0.01	0.00	1	Cu. Lt. haze.	e.	1 2	A.-cu. Cu.	sw. ne.
11	30.07	30.08	77.0	74.0	80	72	67.3	61	68.0	74	ne.	7	ne.	5	0.00	0.00	4	Cu. Lt. haze.	e.	9	Cu.	ne.
12	30.07	30.06	75.5	74.0	79	71	65.5	58	67.0	69	ne.	4	ne.	9	T.	T.	1 5	Ci. Cu.	0 e.	10	Cu.	se.
13	30.08	30.09	75.0	73.5	80	70	64.0	54	65.0	63	e.	5	e.	9	T.	T.	4	Cu.	e.	4	Cu.	ne.
14	30.14	30.11	73.0	73.5	79	69	64.0	61	66.0	67	ne.	10	ne.	10	0.00	T.	1 7	A.-s. S.-cu.	0 e.	10	N.	ne.
15	30.16	30.12	74.0	73.0	80	69	66.0	65	67.0	73	e.	10	ne.	9	0.01	0.01	8	A.-cu.	e.	9	N.	?
16	30.12	30.11	74.0	74.0	79	67	65.0	61	64.0	58	e.	16	ne.	8	0.02	0.00	2 7	A.-cu. Cu.	e. e.	2 3	Cu. S.	ne. ne.
17	30.09	30.06	74.4	73.0	79	70	65.0	60	64.0	61	e.	9	e.	6	0.01	T.	9	S.-cu.	e.	Few 2	Cu. S.	ne. ne.
18	30.08	30.08	76.0	71.5	81	70	66.0	59	67.5	82	ne.	6	ne.	5	0.00	0.06	1 6	A.-cu. Cu.	0 e.	6	S.	ne.
19	30.10	30.12	75.8	74.0	80	71	69.2	71	70.0	82	ne.	8	e.	8	T.	T.	2 7	Ci. N.	w. e.	10	S.	e.
20	30.12	30.10	77.1	74.5	80	72	68.5	65	68.0	72	ne.	8	ne.	2	T.	0.00	9	S.-cu.	ne.	0	0	0
21	30.08	30.06	74.4	73.5	79	70	66.0	64	67.0	71	e.	5	ne.	10	T.	T.	8	Cu.	e.	8	S.	e.
22	30.05	30.04	73.0	71.0	78	68	67.0	71	67.0	81	ne.	15	e.	20	0.02	0.18	4 5	S.-cu. N.	e. e.	9	N.	ne.
23	30.06	30.00	73.0	73.5	76	70	67.0	73	67.0	71	ne.	8	ne.	9	0.02	0.01	9	S.-cu.	e.	Few	S.-cu.	ne.
24	30.04	30.03	76.0	74.0	80	72	66.0	59	67.0	69	e.	14	e.	9	0.00	0.00	3 1	Ci.-s. Cu.	se. e.	0	0	0
25	30.07	30.05	74.0	73.0	80	70	69.0	78	69.0	82	e.	8	e.	9	0.02	T.	9	S.-cu.	se.	5	S.	ne.
26	30.09	30.03	75.0	75.5	81	71	69.0	74	68.0	68	ne.	7	ne.	10	0.01	0.00	7 3	Ci.-s. S.-cu.	ne. e.	2 5	A.-s. S.	sw. ne.
27	30.09	30.08	79.0	75.0	82	74	69.0	60	67.0	66	e.	7	ne.	5	0.00	0.00	7 Few	Ci.-cu. Cu.	w. e.	0	0	0
28	30.11	30.09	77.4	74.0	82	72	66.0	54	67.0	69	e.	7	ne.	15	0.00	0.00	4 1	Ci.-s. Cu.	w. e.	Few Few	S.-cu. Cu.	ne. ne.
29	30.12	30.09	75.3	75.0	81	72	66.4	62	65.5	60	ne.	6	ne.	7	0.00	0.00	5	A.-cu.	e.	Few	S.-cu.	ne.
30	30.10	30.09	75.4	74.0	80	72	67.0	65	66.0	65	e.	4	ne.	8	0.00	0.00	8	S.-cu.	ne.	Few	S.-cu.	ne.
31	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Mean	30.086	30.068	75.6	73.8	80.0	70.7	66.7	62.7	66.9	69.9	ne.	8.1	ne.	9.0	0.13	0.26	6.4	Cu.	e.	4.5	Cu.	ne.

Observations are made at 8 a.m. and 8 p. m., local standard time, which is that of 157° 30′ west, and is 5h and 30m slower than 75th meridian time. *Pressure values are reduced to sea level and standard gravity.

RAINFALL IN JAMAICA.

Thru the kindness of Mr. Maxwell Hall, meteorologist to the government of Jamaica and now in charge of the meteorological service of that island, we have received the following data:

Comparative table of rainfall.

[Based upon the average stations only.]

JUNE, 1908.

Divisions.	Relative area.	Number of stations.	Rainfall.	
			1908.	Average.
	Per cent.		*Inches.*	*Inches.*
Northeastern division	25	21	14.12	8.52
Northern division	22	49	10.78	4.54
West-central division	26	19	11.27	7.76
Southern division	27	30	10.42	4.67
Means	100	....	11.65	6.42

The rainfall over the island for June, 1908, was therefore twice the average. The greatest rainfall was 25.16 inches at Newport, Manchester, in the southern division[1]; the lowest was 4.40 inches at Black River and White Hall, in the southern division.

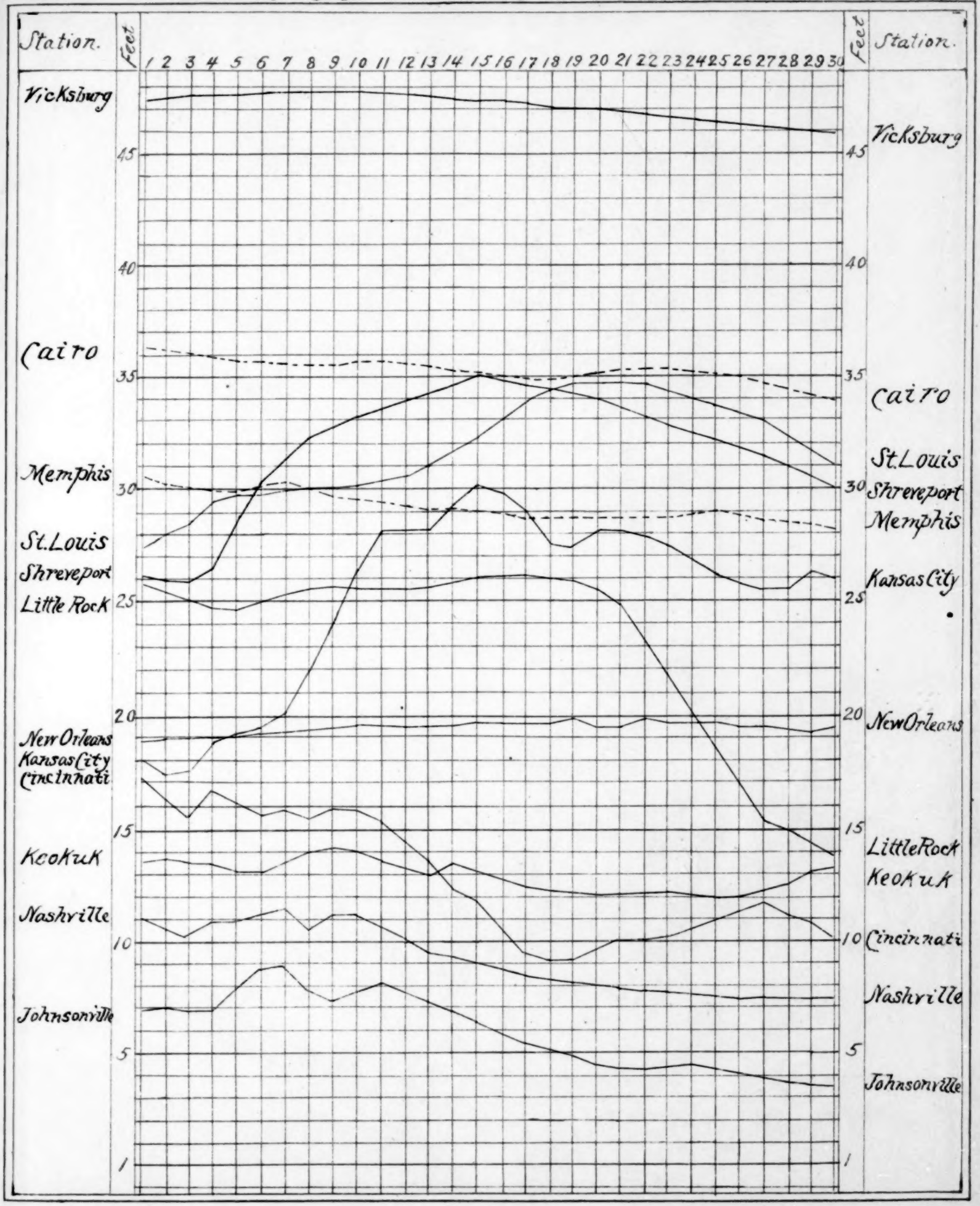
This large island rainfall was almost entirely due to a large and shallow barometric depression, which generated on June 1 and gave much needed rains on the 2d, 3d, and 4th. The conditions were similar to those in 1886, the May rainfall in each case was below the forecast; the barometric fall was too small to attract attention; the rains were heavy and continuous, but this year we escaped the disastrous floods of 1886.

Had it not been for the occurrence of this depression, which may be regarded as accidental in considering rainfall processes, the rainfall for June would have been below the average, and the forecast for July was based upon this circumstance.

Hail fell during thunderstorms at Windsor Pen, Trelawny, on the 10th, at Brownstown on the 20th, and at Mount Edgecombe on the 24th.

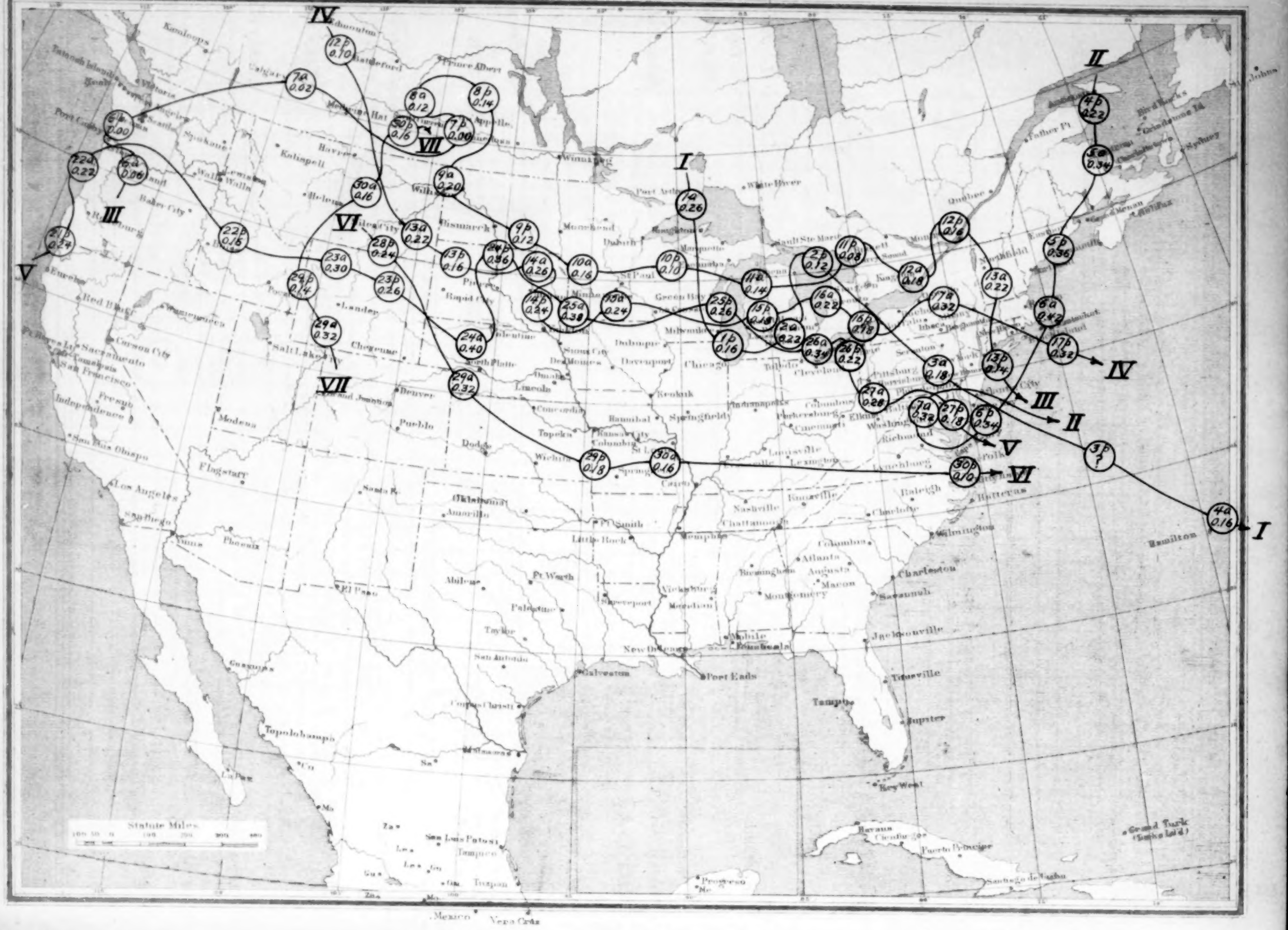
[1] Special inquiry was made as to this exceptionally large fall.

Chart I. Hydrographs for Seven Principal Rivers of the United States, June, 1908.



• Barkerville

Chart II. Tracks of Centers of High Areas, June, 1908.



• Barkerville

Chart III. Tracks of Centers of Low Areas, June, 1908.

Chart III. Tracks of Centers of Low Areas, June, 1908.

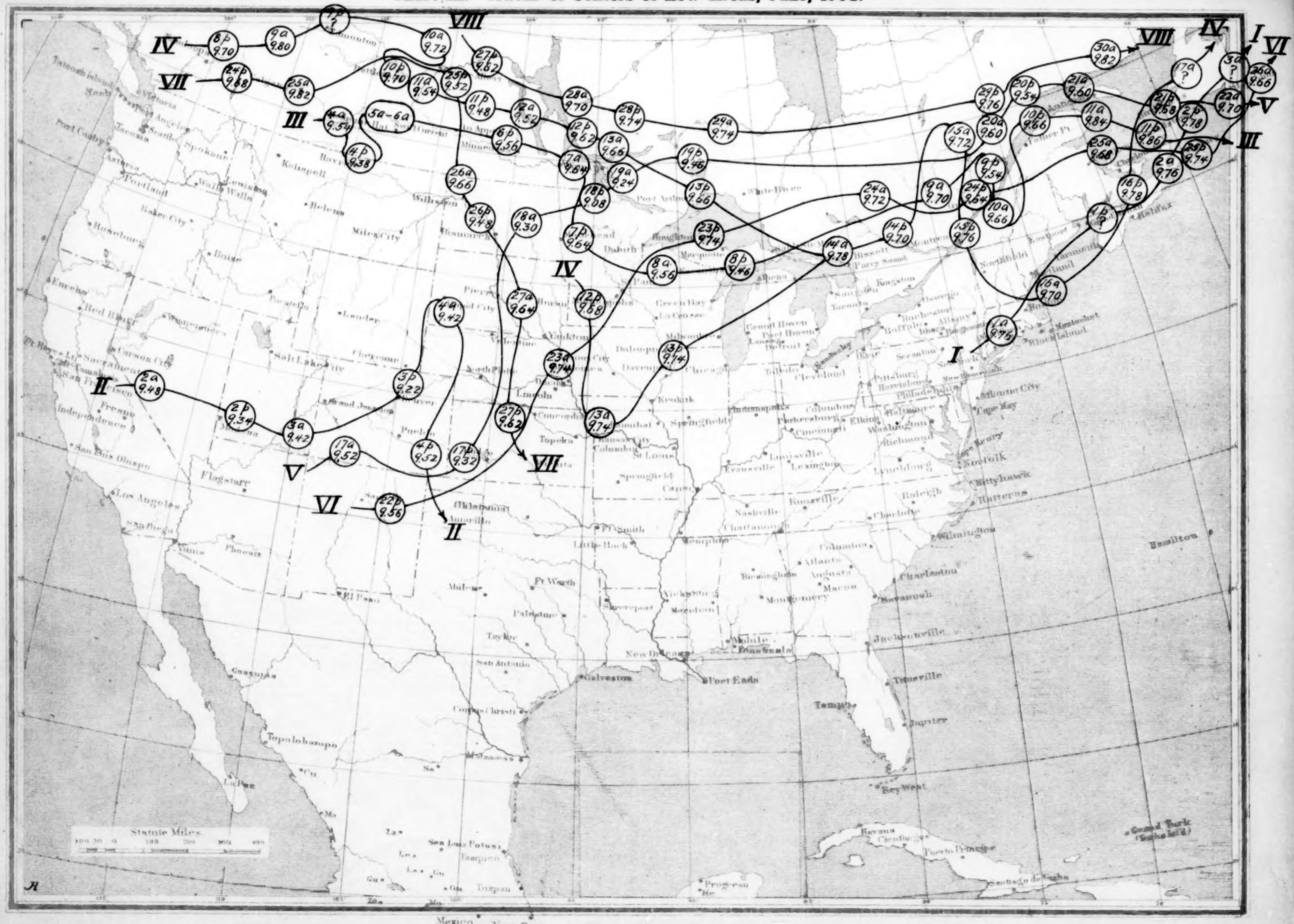


Chart IV. Total Precipitation, June, 1908.

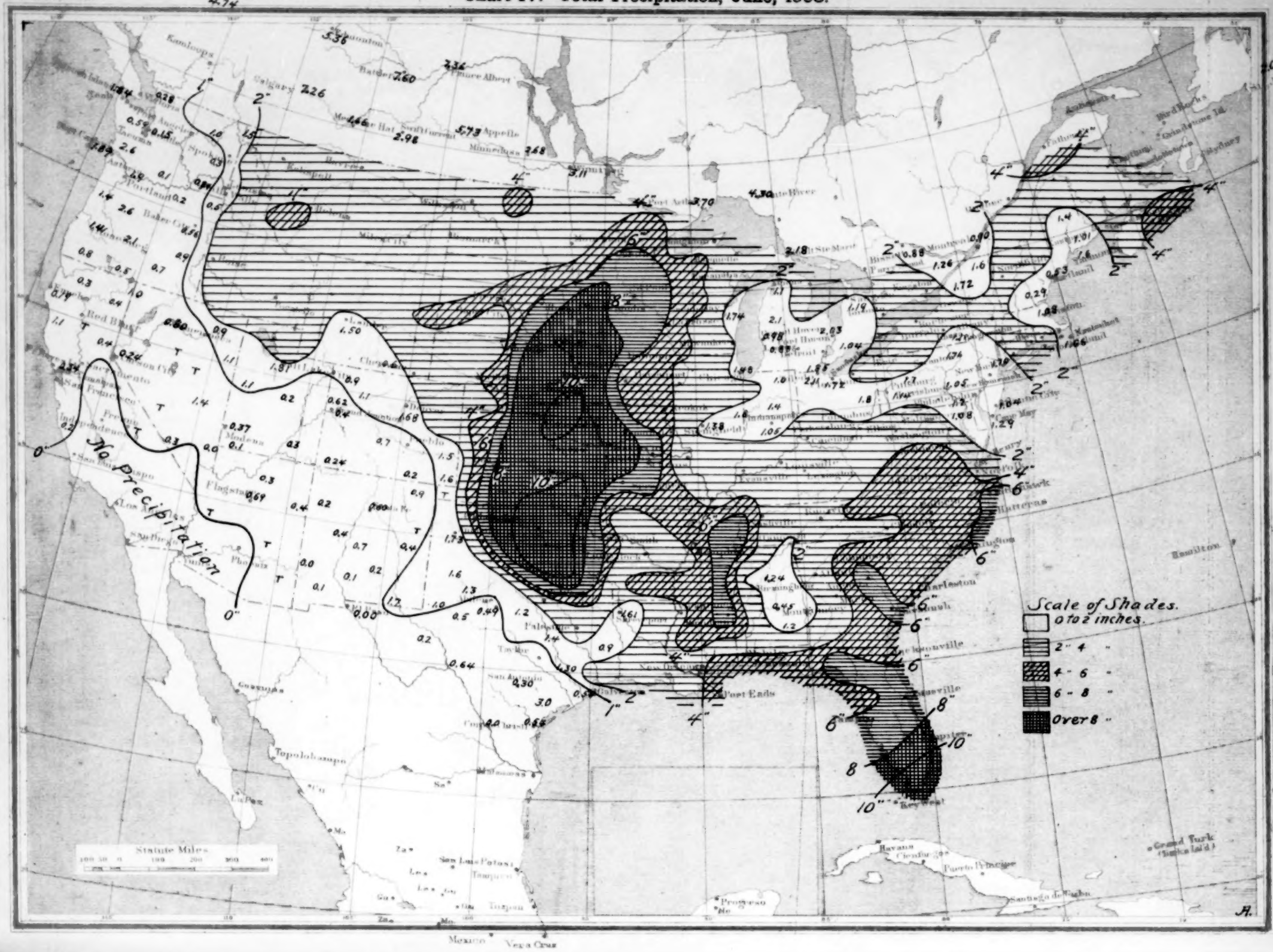


Chart V. Percentage of Clear Sky between Sunrise and Sunset, June, 1908.

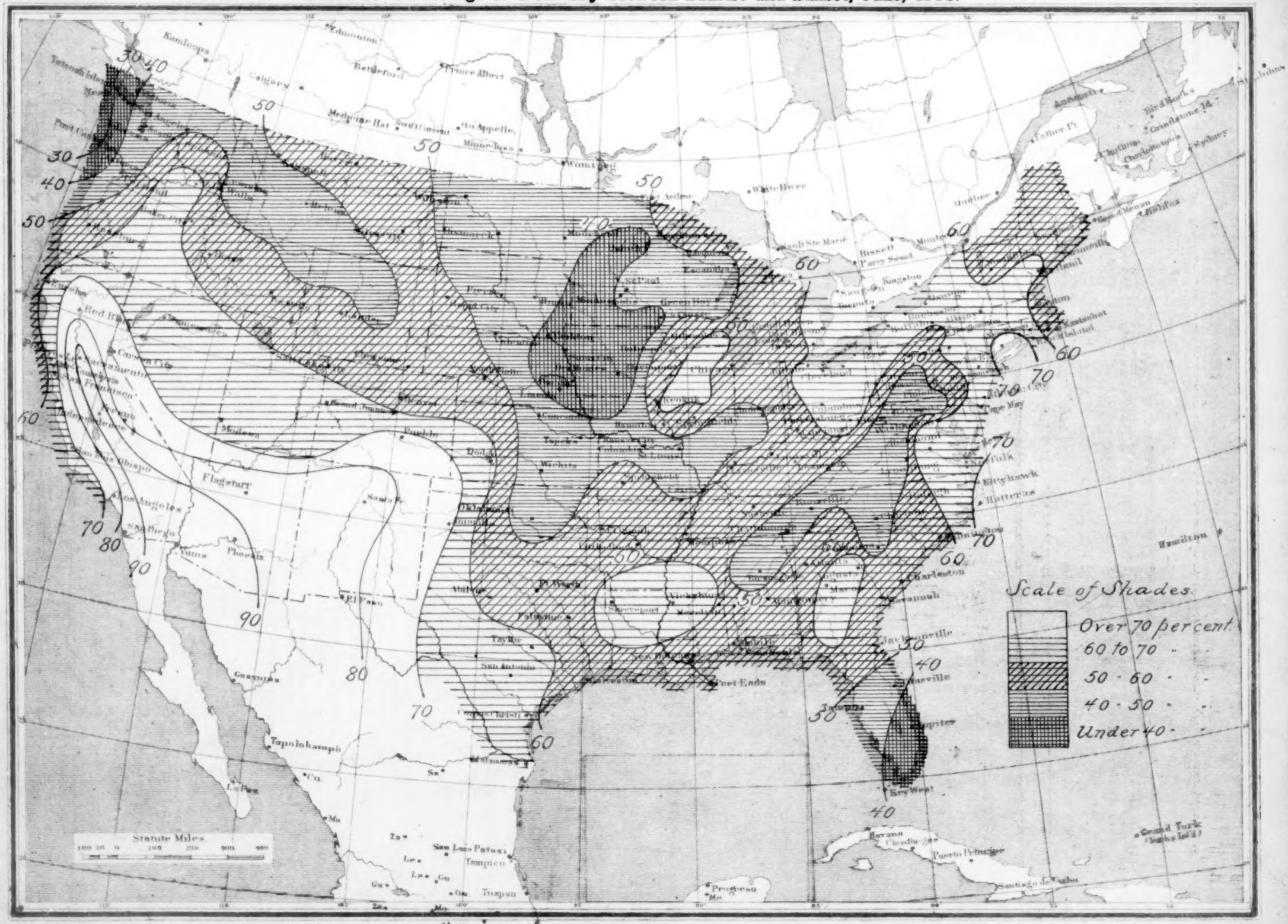
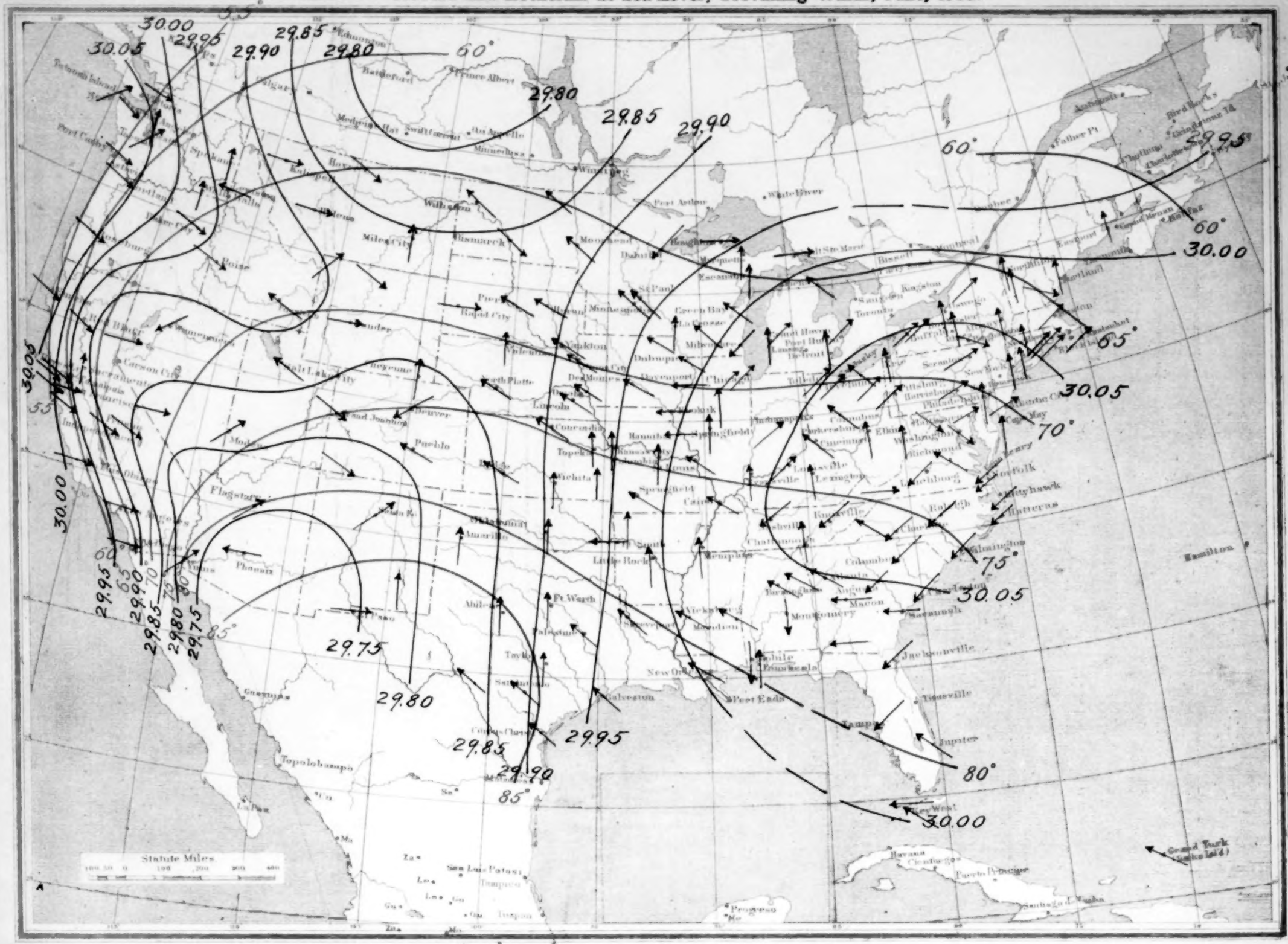



Chart VI. Isobars and Isotherms at Sea Level; Prevailing Winds, June, 1908.